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Meadowbrook Causeway Looking North from Sport Beach, Toward Mainland

RECREATION DEVELOPMENT REQUIRES ROADS and Long Island Is Getting Them

By B. L. VAN SCHAICK
Executive Secretary, L. I. State Park Commission

THAT motoring is more than a matter of business is becoming widely recognized. For years, road construction was so far behind travel needs that all thought was centered on joining cities to cities, towns to towns, and farms to market. Such roads were built to facilitate and expedite traffic at low cost. This meant direct routes with little, if any, thought of scenic interest. This enormous task is still far from complete. Only one-third of our state highway systems which carry 65 per cent of all travel, has been paved with a high type surface.

New Demand Adds to Road Building Task.—But there has been such an insistent demand for pleasure roads where scenic interest and outdoor recreation facilities are the primary consideration, that roads "for pleasure vehicles only," have been started in a number of localities.

It was over a decade ago that Robert Moses became interested in this park and parkway movement. The hordes of motorists in metropolitan New York, wanted a place to go for recreation—they wanted pleasure roads.

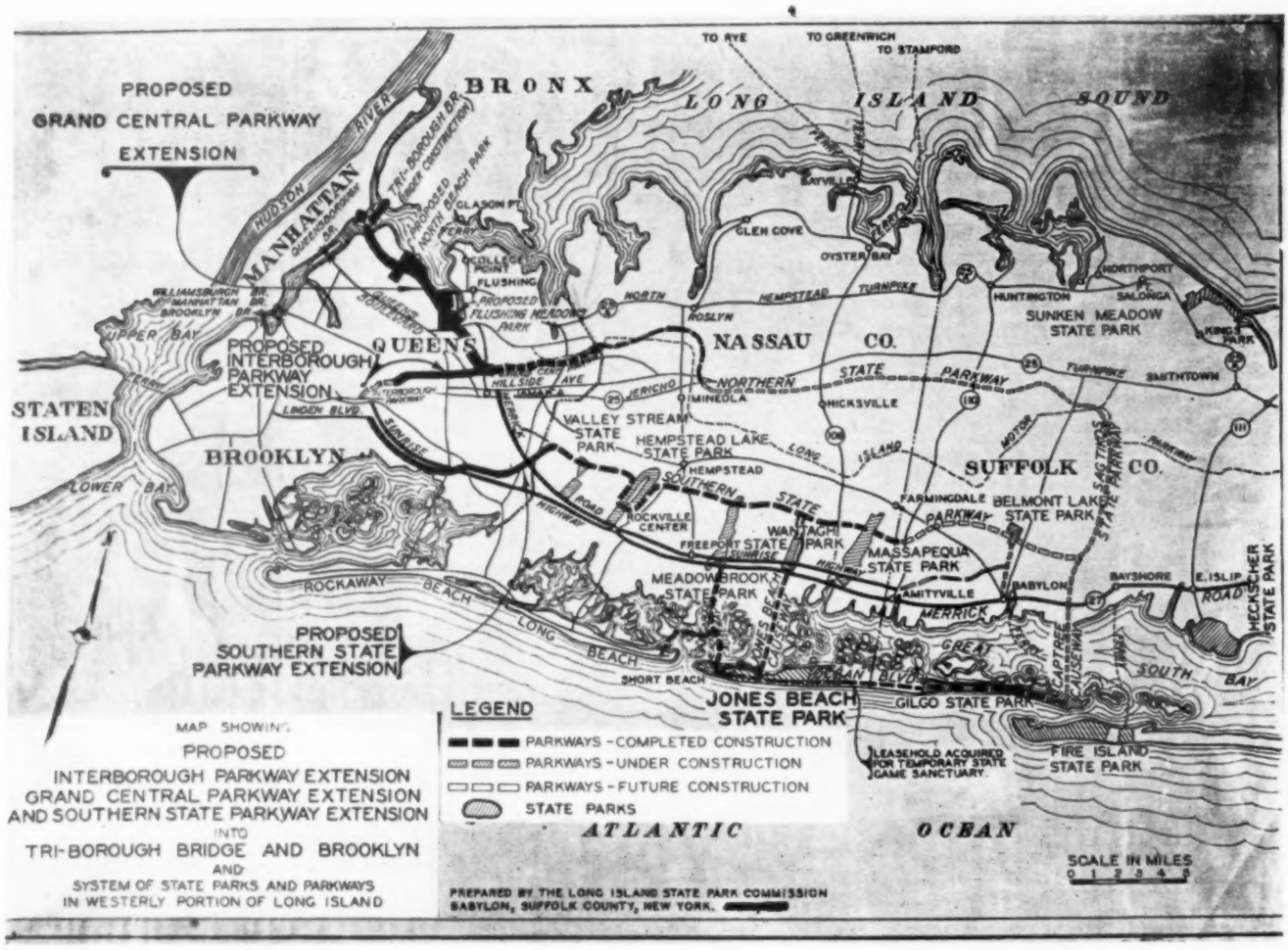
Because of this keen interest in this, when the Long Island State Park Commission was formed in 1924, he was made president.

Long Island State Park Commission a Pioneer in Providing Recreation for Motorists.—Taking advantage of the variety of scenic loveliness and the opportunities for recreation in choosing park sites and planning for their development, the commission set up to establish a comprehensive park system with an adequate system of connecting parkways. Remarkable progress has been made and many miles of 40 and 44 ft. concrete roads are now available.

Of the vast recreation empire under development, Jones Beach is the most ambitious, and is an example of the highest type of improvement. In 1933, 3,200,000 people visited Jones Beach, all of them by motor car or bus.

On the south shore of Long Island, 30 miles from the heart of New York City, Jones Beach was a barren waste of sand and marsh in 1927.

Today the Ocean Parkway, a 20, 40 or 80 ft. road depending on the stage of development of the area through which it passes, skirts the 17 miles of Jones



Map Prepared by Long Island Park Commission Showing Proposed Parkway Extensions

Beach, along the ocean, while 76 acres of concrete parking areas hold 16,000 cars for leisurely people there to enjoy the bathing, boating, golf, tennis, handball, or other sports for which facilities are available.

Joining Ocean Parkway and Jones Beach to the 44 ft. concrete Southern State parkway leading out of New York on Long Island are two causeways. Meadowbrook Causeway, nearing completion,* connects the west end of Jones Beach with Meadowbrook State Park on the south shore of Long Island. A loop also connects with Lido Boulevard on Long Beach which is separated from Jones Beach by Jones inlet.

Five miles east in Wantagh Parkway and Causeway completed in 1929. At the extreme east end of Ocean Parkway, plans include a third causeway to the mainland.

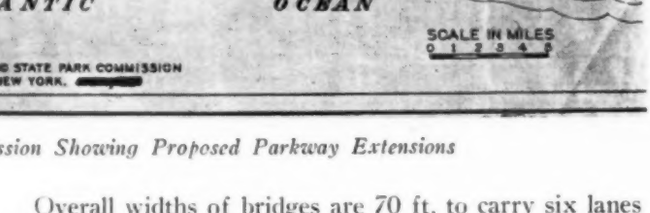
Causeway Construction.—The general design of the two completed causeways is similar. Fill (10,000,000 cu. yd. were required in building the Meadowbrook Causeway) was dredged from the bay after a comprehensive waterway plan was worked out. The waterway provides a minimum mid-channel depth at low tide of 15 ft., with a bottom width of 200 ft. and requires the moving of 35,000,000 cu. yd. of fill.

There are one bascule type and two fixed type bridges on the main section of the Meadowbrook Causeway and the same number on the branch leading to Lido Boulevard on Long Beach. There are also four stone faced reinforced concrete elliptical arch highway grade separations.

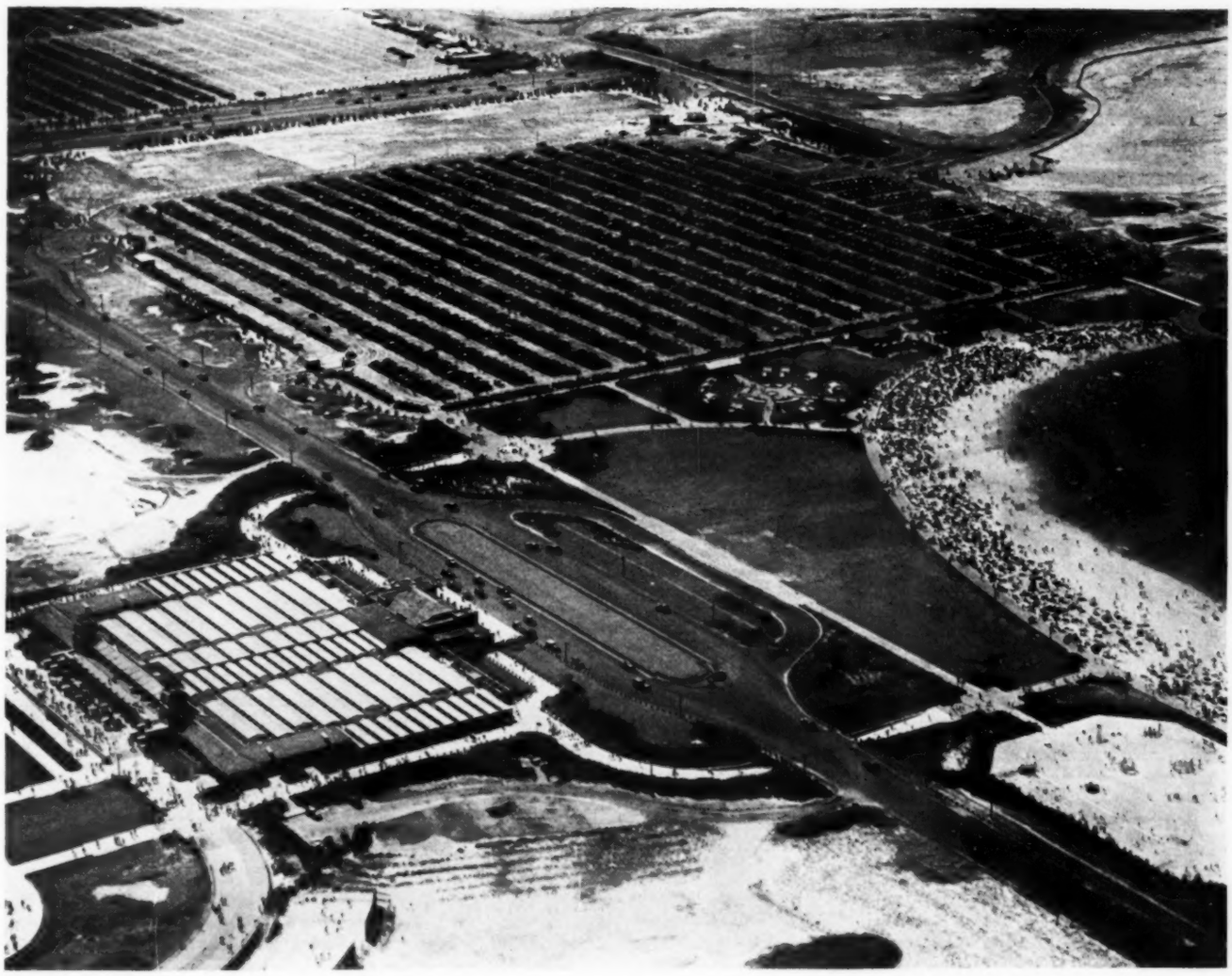
*Meadowbrook Causeway will be opened on Oct. 27.

Overall widths of bridges are 70 ft. to carry six lanes of traffic on the Meadowbrook Causeway, and 54 ft. to carry four lanes of traffic on the Long Beach Loop. The bridges are 102, 510, 575, 638, 678 and 1,478 ft. in length. Bents are on 32 ft. centers.

A total of 1,726 reinforced concrete piles was required for the bridges and trestles. These included 24 by 24 in. piles up to 95 ft. long, 18 in. batter piles and sheet piles for abutments. Concrete with a strength of 3,500 lb. per square inch was required. Piles were cast at a plant set up on Jones Island where a gauntry crane



Concrete Bents for the Causeway Were Placed with Pumperete Equipment



Ocean Boulevard, a Road for "Pleasure Vehicles" Only, Jones Beach Development of Long Island State Park Commission

handled the concrete to the piles, the piles to curing yard, and from curing yard to scow, on which they were towed to position for driving.

Temporary and Permanent Pavement.—From experience on Wantagh Causeway, settlement of the hydraulic fill must be expected for 4 to 5 years. A temporary driving surface was therefore built of compacted cinders covered with a 1½ in. bottom course and a ½ in. top of asphaltic macadam. The temporary surface was placed with unemployed relief labor. Plans call for a permanent surface of concrete when settlement of fill is complete.

The temporary surface of Wantagh Causeway placed in 1929 has already been replaced with concrete. This pavement is of a 1:1¾:3½ mix and built in 8 in. uniform thickness section. It is built in four 10 ft. lanes.

Much study preceded the location of Ocean Parkway. A study of Jones Beach was made from records of the U. S. Coast and Geodetic Survey. Improvements were then placed far enough from the storm water line that the original dunes, left intact, act as a natural protective bearer. Slopes of the sand fill to the roadway were also built to dissipate the action of waves.

In placing the concrete pavement on the settled sand fill subgrade, as much water was sprinkled on the subgrade as it would readily absorb. Concrete was then placed directly on the moist subgrade. A bituminous emulsion was used to cure the pavement, being sprayed on immediately after the finishing operation.

The parking areas (76 acres) are paved with a lightly reinforced five inch concrete slab, with half inch premolded bituminous material at 40 ft. intervals, both transversely and longitudinally.

To safeguard the heavy pedestrian traffic crossing Ocean Parkway, 10 underpasses have been built.

Financing.—Work on the Meadowbrook project in 1934 has been financed by the Long Island State Park Commission, acting as the Jones Beach State Park Authority, which secured an RFC loan of $5,050,000. To repay this is pledged receipts from tolls for crossing the causeways. Twenty-five cents will be charged for a round trip on the Meadowbrook and Wantagh Causeways between the mainland and the beach. It is expected that this revenue will pay off the loan in 20 to 25 years. To keep the cost of using the facilities low, the parking charge will be reduced from 50 to 25 ct.

All of this work with the exception of the grade separation structure on Jones Island and the temporary surfaces, has been built by contract. Contractors include Arundel Corp., Frederick Snare Corp., Johnson, Drake and Piper and Good Roads Engineering and Contracting Co., Inc.

Robert Moses is president of the Long Island State Park Comission; A. E. Howland is chief engineer; and Sidney Shapiro is construction engineer in charge of the entire project.

METHODS OF RESURFACING STREETS In Indianapolis, Ind.

By M. G. JOHNSON
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PRACTICALLY all the street resurfacing during the last three years in Indianapolis has been constructed using reinforced concrete. This totals approximately 150,000 sq. yd. Many of the streets which have been resurfaced with concrete are in the business districts, and some were formerly occupied by street car tracks. The street car tracks were removed before resurfacing and widening, and trackless trolleys now operate over these streets. The cost of concrete resurfacing has been less than other types of permanent improvement and it has proven very satisfactory on our main arteries of the city.

Thickness, Joints, etc.—A slab with a minimum thickness of 5 in. is specified including mesh reinforcement, 67 lb. per 100 sq. ft. All concrete used must pass compression test of 3,500 lb. per square inch or more at 28 days. A reduction in proportion to the deficiency is made from the final estimate, if pavement tests are below this minimum. Dummy joints are constructed in the slab at approximately 35-ft. intervals and expansion joints at approximately 105-ft. intervals. Longitudinal joints are placed depending upon the width of the street so as to construct a slab ranging from 9 to 13 ft. in width. These joints also serve to divide the pavement into traffic lanes.

Central Mix or Job Mix Concrete.—The specifications allow the use of job mix or central mixing plant concrete under scientific control. However, the majority of concrete used for resurfacing has been delivered from a central mixing plant in agitators. The specifications on file for central mixing plant concrete require that the contractor first receive written approval of his plant and equipment from the city engineer that we may be assure that the plant is properly equipped for scientific control. The cement content is *not specified* under this central mix specifications providing the operator procures the proper strength and places an engineer in control of the plant. The testing and approval of the materials and the method of proportioning the materials are under our supervision. The plant in operation at the present time in Indianapolis certifies *all* the concrete produced or leaving the plant and the city has never received concrete deficient in strength justifying any penalty. The use of plant mix concrete eliminates the storage of materials near the job and in the business districts, in particular, it relieves congestion already increased due to closing of street under construction. The entire plan of operation in street construction can be easily adjusted also to aid the business man as well as the street car and bus lines in operation.

High Early Strength Cement.—High early strength cement was used in the concrete placed at numerous intersections to reduce the traffic inconvenience as well as hazards. In some instances, the use of high early strength cement was included in portions of the slab for the entire block. These intersections, and slabs of the pavement were opened to traffic from 24 to 30 hours after placing of concrete. The additional cost of the use of this cement is more than justified, in allowing business to continue with the minimum interruption and its use has certainly been appreciated and commented upon during the last two or three years.

Winter Construction.—Heated concrete using high early strength cement from central mixing plant was used last year during cold weather without seriously increasing the cost. All aggregates were heated at the plant as well as the water and the concrete was delivered to the project at a temperature ranging from 60° to 70°. Heavy straw covering was used for protection. It is surprising to note the length of time the slab holds the heat, allowing the concrete to set naturally as in warm weather.

In resurfacing streets, in particular, during cold weather, the contractor is relieved of sub-grade worry and the only hazard of placing concrete on frozen material would be in trenches where new drainage or utility connections are placed, which can be easily protected from frost. If trench has been subjected to freezing or frost, it can easily be thawed out before resurfacing.

In my opinion, any of the hazards of winter street construction which can be eliminated by adopting new paving developments from an engineering standpoint, and which will increase the length of the construction season, is certainly in keeping with the employment problem of today. On many of our resurfacing projects, traffic has been maintained on the old base throughout the entire period of construction, until portion of it are completed, eliminating the detours.

Marketing Concrete on Quality Basis.—I now wish to give my personal opinion and emphasize the importance of testing concrete to those, if any, who as yet have not adopted some method of determining the quality of concrete used in city streets. Upon adoption of a strength specification in our city, the days of an inspector, who sat in the shade while the contractor placed three out of five bags in a batch of concrete has passed. In the future a large portion of the expenditures for pavements will be allotted to the resurfacing of old pavements. When many of these original slabs were constructed, the engineer was forced to leave the question of quality to the inspector, who counted the cement sacks, etc., but surely this antique method must be eliminated when the old pavements need rejuvenation. It is entirely up to us engineers and officials of municipalities to see that our projects, which are resurfaced, are of quality to withstand the present and future traffic without any guess work whatsoever.

In my estimation it is gross negligence for an engineer to approve the expenditures of money for this type of construction and then adopt no method whatsoever

to insure that he will obtain a product of the highest possible quality for the money disbursed. In the past on many projects, it was *time, weather,* or *heavy traffic* that proved to the engineer that the concrete was inferior or of good quality. Today the engineer should have the absolute facts before 15 days have passed regardless of the qualifications of the inspectors on the job.

In adopting a strength specification, the burden of proof of quality is shifted to the contractor, where it rightfully belongs. To me, it is ridiculous that a contractor who is a manufacturer of such a high priced product should have to question *the buyer* as to the quality of his *own product*. The day that he assumes the responsibility of producing a definite quality, he must become seriously interested in the material's qualifications and finished product. He becomes a producer of a product which he sells upon its merit and quality rather than inspection and the enormous amount of technicalities, regarding materials, tests, mixing, water cement ratio, etc., which are now forced upon the contractor will become theoretically a part of his organization.

The contractor's position in the paving industry completely reverses itself. He then voluntarily becomes also a promoter of the product he sells for he seeks the best raw material possible to produce an economically complete product. The material men also assume the same role and seek knowledge as well as advertise in reference to the merits of their materials. He naturally is forced to produce excellent quality to continue in business. The serious *results* of trying to produce a product lacking proper experience in its manufacture is a problem immediately solved and forever.

To me it is just as ridiculous for a state or municipal engineer or official to state in detail the composition which a manufacturer shall use in his tires or soap or gasoline, etc., as it is for us to do the same to a contractor producing concrete, and then when the finished product has been in use sometimes criticize, or refuse payment for same.

Acknowledgment.—The foregoing is a paper presented at the recent Congress on Public Works and Municipal Engineering, held Sept. 24-28 at Rochester, N. Y., by this American Society of Municipal Engineers and the International Association of Public Works Officials.

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Street and Highway Definitions

The Committee on Street Thoroughfares Manual of the American Society of Civil Engineers in its report in the August Proceedings of the Society proposes the following definitions of terms used in its report and recommends their general adoption in the interests of clarity and brevity. The committee consists of W. W. Crosby, Chairman, Jacob L. Crane, Jr., Jay Downer, John P. Hallihan, W. W. Horner, Daniel L. Turner, George H. Herrold, Sponsor.

The definitions follow:

Alley—A street less than three traffic lanes in width, usually in the rear of building lots, and designed for local service only.

Avenue—See *Road* or *Street.*

Boulevard—An important street of extraordinary width (not less than 120 ft. wide), with ample provisions for shade trees or ornamental planting. A boulevard is not intended for trucking but is readily available and attractive to pleasure traffic, and adjacent to property that may be peculiarly adapte dto furnishing imposing settings for public buildings or for the highest type of private residences. In its design ample or generous provisions are made for pedestrians, for restful recreation, or contemplation, and for ornamentation.

By-Pass Road or Route—A road or route providing for the passage of through traffic around, instead of through, a locality.

Freeway—A highway to which there is no vehicular access from abutting properties.

Highway—The entire right of way devoted to public travel, including the sidewalks and other public spaces.

Arterial Highway: A highway for vehicular traffic that is a main channel, with many tributaries, and the roadway of which is required, by traffic frequency, to be not less than four traffic lanes wide.

Express Highway: A highway having an express roadway.

Express Roadway: A roadway for fast minimum-stop traffic, with separated opposite-direction free-traffic lanes, and without grade crossings.

Express Traffic: Non-stop, fast traffic with distantly separated origin and destination.

Expressway: A highway for express traffic exclusively.

Major Highway: A highway forming an essential part of a highway system for a region, such as a State, and the right of way of which is not less than 100 ft. wide.

Secondary Highway: (1) A highway with right of way less than 100 ft. wide, tributary to, or parallel with, and of less importance than, a major highway; (2) a highway with right of way less than 100 ft. wide.

Super-Highway: A highway to accommodate mass passenger transportation on rails, in addition to all other highway functions, including local service to abutting properties.

Lane—A narrow secondary highway. A strip of roadway passed over by successive vehicles traveling in the same direction, including in its width an excess on both sides for the clearance of passed vehicles.

Loading Lane: The strip of roadway reserved, or customarily used for, the loading of vehicles.

Parking Lane: The strip of roadway reserved, or customarily used for the parking of vehicles.

Standing Lane: The strip of roadway reserved, or customarily used for standing vehicles.

Free Traffic Lane: A lane of traffic not used for loading, parking or standing, nor containing street railway tracks, along which traffic may proceed in one direction freely and without interruption, except by traffic signals and the usual requirements of safety.

Parking—The standing of vehicles, attended or not, for any purpose except the observation of traffic regulation, congestion or signals.

Parkway—A thoroughfare, with a right of way normally not less than 300 ft. wide, planted with trees or other decorative growth, where vehicular access to abutting properties is precluded except by supplementary roadways connecting with that of the parkway at widely separated intervals; and where grade crossings with main intersecting highways are eliminated.

Plaisance—A short parkway, extraordinarily ornamented by plantations, and where parking spaces for the enjoyment of the views are provided for pleasure vehicles. A narrow park on which houses face, the street of vehicular approach to the house being in the rear.

Planting Space—The strip or area of the highway set aside for grass, trees, shrubs, flowers, statuary, and other ornamentation. (Sometimes, regrettably and confusingly, the planting space is still referred to as "Parking.")

Road—A highway outside an urban district. This term is sometimes used to designate a meandering street discordant with the general street plan.

Roadway—That part of the highway particularly devoted to the use of vehicles.

Street—A highway in an urban district.

Heavy Traffic Street: A street carrying more than the average traffic per square yard of roadway.

Major Residential Street: A street through a purely residential district, so located as to be a satisfactory distributor to other residential streets of the district; it serves the district as a traffic-way in contrast to serving merely the block unit; and usually requires a roadway width of not less than three traffic lanes.

Mercantile Street: A street devoted to local commerce.

Street Thoroughfare—A street carrying through traffic from and to other than the abutting properties.

Traffic—The movement of goods and persons on the highways.

Fast Traffic: Motor traffic proceeding continuously at speeds greater than 40 miles per hour.

Heavy Traffic: Traffic of more than the average per square yard of roadway, with consideration of both the number and the weights of the traffic unit.

All Dressed Up and No Place to Go On a Narrow Highway 10 Years Ago. Four O'clock on a Sunday at a Road Intersection in Cook County, Illinois. The Long Line of Automobiles Extending Back for Several Miles Is Waiting for the Signal of the Traffic Policeman to Proceed on Their Way to Chicago

ELBOW ROOM

Why Highway Congestion Must Be Relieved

By W. W. CROSBY

Consulting Engineer, Coronado, Calif.
Formerly Chief Engineer State Roads Commission of Maryland

"THIS country's greatest need" may have been met by the "good five-cent seegar" visualized by Vice President Marshall, but the next need—the elbow-room for it—has not. Naturally, the seegar would be an outdoor smoke, and its up-to-date smokers motorized. Once more we realize the need of relief from congestion on our highways.

Whoever has tried to motor any distance over the "Primary Routes" of a state or over a "Federal Aid Route" has fretted or cursed at the interference to his "smoking up" by the congestion caused by lack of room, by the intrusion of parking and of crossing traffic, or by the possible—not to say probable—intrusion of sudden obstacles such as pedestrians, children at play, or cattle from the sides of the open roadway, when speed was desired and otherwise was entirely and properly permissible.

Road surfacings, grades, and alignment for roadways are being standardized everywhere to furnish comfortable riding at 60 to 80 or even more miles per hour. Cars are likewise sold (and tires are or soon will be made) to run with reasonable comfort, economy, and safety at such speeds. Three or four hundred miles is now a moderate day's run, though to make it one has to "smoke up" to 60 miles per hour at questionable opportunities in order to compensate for the 20 miles per hour or less speed annoyingly forced, with great nervous strain, on both driver and passenger in many congested stretches of road.

It isn't the speed limits that restrict the freedom of the individual in these United States, but the lack of opportunity to go the limit steadily when no one else should say him "Nay!"

Why Is a Speed Limit?—No one has suggested that a speed limit should be placed on airplanes. Why is highway speed so narrowly limited? Isn't it that we are not so much interested in the speeder but we are keenly aware of his closeness on the road and of the possibilities for injury to us when he dashes by or when we relax our own watchfulness for a moment in his proximity?

Nationally we are keen to hurry and to get where we are going. Yet we are building yearly thousands of miles of roads to no such end. In many cases the vast expenditures, aggregating millions of dollars annually, are really being used along lines that will eventually make matters worse than they now are.

Highway Improvement Mostly Evolutionary.—Highway improvement, which is only about 40 years old in this country, has been mostly evolutionary. The successive problems of each year have been met and solved as circumstances permitted. When the era of "Good Roads" began in America, the highway ideal was simply an "all the year" surface, which could be relied upon for use every day regardless of weather. Ten years later discussion was rife over the kind of surface that would "stay put," without excessive construction or maintenance costs, and satisfy the demands of both animal and motor traffic.

The succeeding ten years produced problems connected with the speedier and more frequent automobile traffic, with its heavier weights, its need for less abrupt curves and for wider traffic lanes. This decade brought us—ten years ago now—to the outstanding problems of safety on the highways, directness of routes (highway location), and, recently perhaps, to that one of constantly increasing importance, i.e., of the capacity of a street or of a highway system for meeting the needs of "peaks" (both in speeds a in numbers) of traffic.

Details of roadway construction have become quite generally standardized. The present question is: How shall this perfected technic now be used to develop that capacity and to satisfy best the recognizable need by speed, through motor traffic, which is numerous enough at all times to conflict with the slower local traffic, and reaches overwhelming peaks during perhaps daily periods, and which demands ways on which to operate with a maximum of safety and convenience for all concerned?

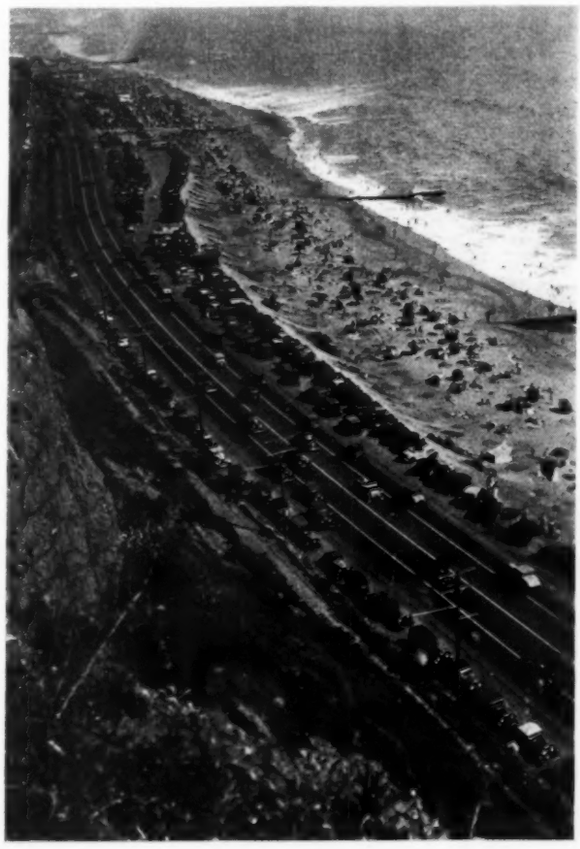
It seems that a satisfactory solution of the problem of providing for directness, speed, and comfort (including under the latter the "intangible" that mean so much to us all) with safety and convenience in the maximum

degree to large numbers of both through and local traffic has not yet been widely agreed upon.

A New Kind of Highway a Necessity.—Under the growing demands—on the one hand for opportunities to maintain high speeds by through traffic, and on the other, for protection from such dangerous vehicles and for convenience to local traffic and abuttors—a new sort of "highway" has been visualized by a few for some years as a coming necessity. The common highway (embracing roads, streets, boulevards, and some parkways) assures to its abutting properties the rights of access and the enjoyment of all the usual privileges due to their frontage on it or contact with it. That fact has had much to do with the determination of the traffic capacity of a highway. It is responsible for some of the major defects in the results attempted for satisfaction to the demands of traffic for the "improvement" of the highway, when fast through-traffic was simultaneously introduced into the local problem.

Too often the pressure of the immediate need has concentrated attention on the provision of a suitable surface, or the widening of an existing street, or the location of an ordinary road to connect traffic *foci* when the demands thus responded to were but symptoms of a trouble that required, for more than its temporary relief, a deeper insight and a more radical treatment in order to afford durable satisfaction or even to avoid the eventual aggrevation of the trouble itself.

Street Widening Futile.—The most perfect pavement will not satisfy the demands of traffic if it is in the wrong location. Merely widening a street will be equally futile where a dense mixture of local and through traffic exists, cross streets at grade are frequent, and congestion or danger must be relieved. The capacity of a highway cannot be even approached satisfactorily where traffic control is necessary for safety or where a heterogeneous mixture of local and through traffic is interrupted by pedestrians and by parking vehicles moving in and out.



Ordinary Sunday Traffic on a State Highway North of Santa Monica, Calif.

Wherever through traffic must be provided for we must stop doing business at the curb and get the latter entirely out of the through roadway—*behind the sidewalks.*

Segregation of Traffic the Solution.—The solution of most of the problems heretofore outlined lies in segregating the highway traffic, and then in providing separate channels for those elements of it that conflict, so that each classification may function safely, conveniently, and efficiently. For the safety and convenience of local traffic, the through traffic must be provided with one or more channels apart from those of local use. These may be adjoining if separate. Usually, whether from the gregarious or the commercial instincts of humanity, they later become adjoining even if originally built more or less isolated.

The Present Development of Highways.—The present development of our roads (many of which later become streets) usually proceeds as follows. The needs for a better surface on the old traveled way become overwhelming, and funds therefor are provided. A "two-lane" (say, 20 ft. wide) pavement is built, with some compromises in matters of grade and alignment to satisfy the abuttors, along the old right-of-way, which latter is seldom of a width as great as 100 ft. and is often much less.

As soon as the surface betterment is established, development of the adjacent property begins and is carried out as near the side lines of the pavement as the road authorities will countenance. Often the business facilities actually intrude on the edges of the roadway, as in the case of ramps up to barns, or driveways sloping into farm grounds, or where the "pumps" of gasoline stations are placed close to the pavement. Even fruit and vegetable stands are more or less durably constructed within the right-of-way.

A "Stringtown-on-the-Pike" is born. As it grows the traffic on the pavement becomes more numerous, and the local traffic interferes with the through, the slower with the faster. Then comes the demand for relief by widening the pavement, and the latter may be made—often with some difficulties because of the above-mentioned excresences—forty or more feet wide. Soon it is found that conditions are worse than ever and that the difficulties of relieving them are far greater.

The Need for Adequate Right-of-Way.—Had sufficient width of right-of-way been demanded before the first modern surfacing was laid, and had the road authorities held proper ideals in the first place, with a recognition of certain now established principles, most of the obstacles to eventual satisfaction of the traffic might have been avoided. Also it would have been possible to have used, stey by step, the wider right-of-way to advantage without loss to the public or to the individual owners of the adjoining land.

As things so often are though, when actual progress is, as above outlined, congestion becomes worse and worse in spite of expenditures; a point is reached where relief is undeniable; that relief can only be had by excessive costs for additional right-of-way on the old location or for "double-decking" the street; or a new attempt at relief is made by a "by-pass" of the section in question.

And then too often the same development takes place on the by-pass, with depreciation of property values and "blight" falling on the original too prosperous district.

We can now avoid such "mires," in the case of by-

passes and of new roads at least, by getting a sufficient width of right-of-way in each case before the land is boosted in price because of the pavement construction or the prospects therefor. And, if in such cases a minimum width of 250 ft. were taken, it would be possible to construct the ultimate highway (and its various roadways) gradually and consecutively without any necessity for abandoning portions of it later. One roadway first built for general use could later form part of the ultimate throughway. Service roads at the sides within the public right-of-way could be added as abutting property developments (kept back on private lands) might warrant. The other side of the through roadway could be added when needed for the separation of opposing fast-traffic streams. Parking, roadside beautification, sidewalks, bridle-paths, and even street railway tracks could all be accommodated within such a public right-of-way. Best of all, perhaps, there would be no danger of blight for the abutting property. As a matter of fact, with such a type of highway, the more it developed along such lines the more valuable the adjacent property would become.

Recreational Opportunities of Roads.—In this connection let it be emphasized that much thought and effort are now being properly given toward beautifying the roadsides and to making highway travel enjoyable. A sort of recognition of the recreational opportunities afforded by attractive roads has begun to be general in spite of the strange persistence in some quarters on that bigoted dictum to the effect that "road improvement is only justifiable to the extent of its pecuniary return to vehicle owners." Wider rights-of-way will provide opportunity for embellishment, as well as for some protection against signboard nuisances and may help to get rid of some "marginal lands" now unprofitably cultivated.

At the beginning of modern road improvement in this country, the clamor of all center of population, large and small, was to have the "state road" run along the "main street." Soon the disadvantages of so doing became evident. Ten or fifteen years ago now the movement began to by-pass the through traffic and to avoid any further location of through routes where local traffic would conflict with that hurrying past to a farther destination and impatient to escape from the nuisance of the locality.

Failure of By-Passes.—At first the by-passes afforded some relief from the old conditions, but in too many cases that relief was obscured or submerged under other even more serious objections thus created or developed. The failures to secure satisfaction through the by-passes were due to two causes:

First—The inadequacies of the by-passes themselves in the way of unattractiveness to through traffic, obscureness, improper sign-posting, objectionable alignment, grades, surfacing, lack of width, indirectness, or other perhaps intangibles that simply made them unpopular; and

Second—The failure to prevent, by proper precautions for sufficient right-of-way widths, in its establishment a by-pass from developing into simply another main street through the accretion later of local business on it when through traffic only was contemplated in its design.

Most by-passes have been developed from existing highways or have been opened up as highways. Hence the abutting properties have had the usual rights of access while the right-of-way widths have been the customary old ones. Inevitably the abuttors have hopefully hatched "hot dog" stands, gas stations, fruit and vegetable stands, lunch counters, and the like along the edges of the roadway. As these developments have grown so also have they reproduced the same objections that were sought to be avoided by the by-pass. The shop-owners on the old main street had grounds for their objections to the by-pass if it simply meant the opening of new business frontage in a locality already supplied with its proper amount for the population involved. But, had a sufficient width of right-of-way for the by-pass been secured primarily, all these later difficulties might have been escaped.

How Italy Handles the Problem.—Ten years ago (1923), with more or less recognition of the universal needs and from a complete understanding of the local wants, the Italian Government proposed to build from some of the larger centers out to popular destinations in the country, modern roadways solely for motors and so built as to accommodate that fast traffic with safety. Access to these roadways and grade crossings thereof were to be limited and, where permitted, especially provided for. By 1926 several miles of these "Autostrada" had been completed—notably between Milan Lake Como and to Monza where an autodrome attracted crowds of motorists.

To anyone whoever attempted to motor along the ordinary highways in the cities of Italy or in their suburbs, with the normal congestion of pedestrians, children at play, animals driven or ridden, vehicles drawn by all sorts of beast and human combinations, and even self-propelled, the Autostrada filled a great want. One felt on entering such a way just as one used to feel in passing from rough or no paving on to sheet asphalt—a vast sense of relief.

Although the U. S. Official Delegates to the Milan International Road Congress in 1926 refused any approval to the Italian idea, it was not long afterward that the primary principles of it were suggested in American under the name of "Freeway." And there has been growing ever since a wider appreciation of the value of and the need for roadways for special traffic where the peculiar characteristics of that traffic can be afforded every opportunity for useful development and, at the same time, other interests be protected with the minimum of conflict and damage.

In this connection it may be interesting to note that the General Reporter (G. Heink, Dresden) on the "4th Question: Traffic, Use and Administration") has proposed to the 7th International Road Congress—this month in session at Munich—some Conclusions prompted by the eleven Papers submitted by road authorities from various parts of the world. A brief extract to indicate the general trend of thought thus collated follows:

* * * "it is essential in towns to adopt a far-sighted policy in regard to the reservation of the land necessary for the proper regulation of the traffic. By means of building schemes or other legislative measures, provision must be made for wide distances between the lines of buildings, grading of roads into those intended for heavy and light traffic, separate tracks for the different types of vehicles and also special areas—either above or below ground—for use as parking places. * * * Restrictions which are rendered necessary owing to the width of the roads or for the protection of the latter should be rendered superfluous by a speedy adaptation of the roads to the volume of traffic. * * * Owing to the greater speed at which motor vehicles travel on open country roads, the danger to traffic in the country is not very much less than it is in the towns. Nevertheless speed limits, which might readily hinder the utilization of technical progress should only be adopted in exceptional cases. * * * The dividing up of the roadway, especially on bends, by means of yellow or white

lines is an excellent means of increasing the safety of traffic."

The peculiar needs of fast traffic can frequently be served, along with all the needs of and with safety to other traffic, within one highway right-of-way, provided a sufficient width for all is taken. That solution will in most cases be better than to attempt the provision of separate right-of-way for each class, for various reasons but especially in view of the natural tendency of traffic and of business developments of property to congregate along the main lines of travel, as heretofore mentioned.

A New Type of Traffic-Way Now Needed.—The new sort of traffic-way is needed in many places now, and that need is growing with increases in traffic numbers and speeds. On it the passage of fast traffic can be afforded with a degree of safety as high as can be practically expected from the very nature of that traffic alone, to the maximum capacity of the roadway, and, at the same time and continguously, the local traffic can be cared for and the abutting property served by both traffic fractions.

To put matters another way: The need is here and growing for a "railroad right-of-way" for through traffic into which local traffic, pedestrians, and stock will be trespassers; where grade-crossings do not occur within reasonably long intervals; and over which right-of-way "express" movement of motor cars may take place at high speeds, in large numbers, at any time, as safely as it is reasonable to expect considering the human factor in the make-up of the "tracks," of the cars, and of the drivers. Coincidentally, the need includes the supplementing of the fast-traffic channels by further continguous provisions for the traffic needs of the abutting properties and the crossing of, as well as the connection to, the through channels by the local traffic. And one strip of land or "right-of-way" should cover it all.

The ordinary high road, even if 150 ft. wide over all, with the widest of pavements, or double roadways, along its center line and the rest of its width utilized by sidewalks or planting or both is not the ideal solution for modern traffic problems, nor are "Autostrada," "Freeways," nor "Expressways" in themselves, useful as they may be for solving special problems in certain cases. Parkways, pleasing as they may be, must, as ordinarily built be classed usually as merely "dressed up" highways.

Providing for Fast Through Traffic.—But we can set up as an ideal, for our more important through roads at least, a sort of a super-highway consisting of two freeways for fast through traffic, supplemented by separate service roadways along one or both sides of a right-of-way at least 250 ft. wide and with room for the desired sidewalks, planting, etc., similar to those already begun outside of Detroit, Michigan.

The former ideal of the "Broad High Way" has been proved inadequate. It was perhaps the best and even all that could have been conceived within the old narrow right-of-way available. Now "Elbow Room" is needed. With it we may accomplish the new ideal whenever such realization is warranted and usually without any serious sacrific for having it in the meantime. Without it we face an impasse if not a catastrophe in traffic matters.

Right-of-way is normally the least costly item in road improvement. When its acquisition has been delayed and values have been enhanced because of developments or prospects therefor, it may be one of the most costly items. In some cases even, the needed space on one location may only be had by extremely expensive "double-decking."

When sufficient width of right-of-way is available, the ultimate construction of the ideal super-highway in all its details may be proceeded with as circumstances permit. The construction of freeways, of service roadways, of planting and park spaces, and the beautification of the whole will be possible as needs arise and funds become available. But if the room to do any or all of this does not exist, the same impasse as so generally now exists ahead of us will be inescapable.

The thought here is that all our national highways should promptly become super-highways, at least outside of built-up districts, and set the example to the states. One way toward accomplishing this end easily in many cases would be to make such sections of them as now run through Government areas, or other lands easily acquired for the purpose, national parkways by extending the present rights-of-way to a minimum width of 300 ft. thus effectually protecting at once and for all the public way from indiscriminate developments. Another beginning could be made where by-passes of already congested sections or re-locations are now being contemplated. Here, similarly, a new right-of-way of 250 ft. or more could often be easily effected and later these sections linked into longer routes of the new type.

Let us wake up to the imminence of events that already are "casting their shadows before." Let us realize that everything is set for motoring speeds double those of the past and that the transitional period of mixed speeds in the same channel is as definitely past as that of mixed horse-drawn and motor traffic: that express traffic must be given its chance "to go and to get somewhere" within its capabilities and at its own risks: that local or leisurely traffic must be provided separately with facilities and comforts and be protected in its rights: that for the general good abuttors must not be injured but must be accommodated by highway provisions: that physical and automatic means and methods, wherever practicable for use, will more satisfactorily solve these problems than signs or policemen; and that Preparedness applies in highway matters as well as in others.

Let an immediate recognition of the necessity for sufficient widths of highway rights-of-way be had by all highway authorities, particularly by those of the states and of the Federal Government. These widths should be actually acquired as promptly as possible and immediately where the land is undeveloped or unimproved. A generous width of at least 250 ft. should be required for all new locations, re-locations, or by-passes before the improvement thereof is fixed.

Let the ideal for trans-continental routes, such as the "Broadway of America" or the "Pacific Highway" be a "Superhighway" rather than a "Broad High Way." Let no national highway in open country be visualized at less than this.

Let all opposing traffic on through highways be physically separated by planting strips and adopt this as a standard form of construction to be carried out at the time of building the highway or to be reached as soon as circumstances will permit. eLt the highway plans comprehend service roadways to abutting properties, that may eventually be needed, when they are being prepared for the routes as a whole, and let business be kept well back from the roadways by widths assigned to walks, plantings, etc., and even by establishing "setback" lines for buildings.

"Elbow Room," and its acquisition in advance: "On these two" hang all the possibilities for future satisfaction to a motorized Nation!

"NUISANCE" TRAFFIC SIGNALS AND HOW TO AVOID THEM

THERE are many "nuisance" signals in operation in this country today—and "Something Ought to Be Done About It."

Though most of us have recognized nuisance signals, it may be well to ponder a bit as to why they are annoying, objectionable, or harmful. Here are some of the reasons:

Unnecessary.—Quite a number of signals have been installed at locations selected by the ward chairman, an influential business man, or a well-meaning but uninformed neighborhood civic organization. Some neighborhoods or communities have decided they just had to have signals because some other competitive neighborhood center or nearby town had signals. This reason may be aptly described as "keeping up with the Jonses."

Most unnecessary signals are of the fixed-time variety; that is, green, yellow and red intervals of predetermined length repeating themselves over and over regardless of how much or how little traffic approaches on the different streets. Hence most unnecessary signals involve much unnecessary delay.

Wrong Solution.—A stop and go signal to some folks is a panacea for all kinds of traffic troubles at intersections. Of course this "just isn't so." At many an intersection where something really does need to be done, the best answer is not a signal but one or more Stop signs or Slow signs with stated speeds, depending upon the computed maximum allowable approach speed; the installation of a safety zone or other traffic islands; the marking of lanes to organize traffic better; the use of the traffic circle; or supervision by a traffic officer. It is quite as important to select the right remedy as it is to give the right kind of a pill to a sick person.

Signals which are the wrong remedies usually result in unnecessary delays and they are very apt to increase accidents instead of to decrease them.

Exasperated by a signal which seems to be unjustified, you visit the official in charge and ask why the signal was installed. He agrees that traffic volume doesn't warrant the signal, but he says "that has been a bad accident location and we put the signal in to reduce accidents." You go to the police accident files and check up. You find that in the year after the signal was installed there were several more accidents than in the year before signalization. "Oh," you say, "but that would be a very rare case."

Three separate studies made by the National Safety Council, the city of Philadelphia, and the state of New Jersey all showed substantially the same results—namely, that signals installed without proper study as to their need, resulted in increased accidents at about one-third of the installations, and that at about 15 per cent more such locations, there was no change in the number of accidents before and after signalization. The principal reason why most traffic signals are demanded is because of an accident situation. Yet these analyses indicate that unstudied installations may not reduce accidents in about one case out of two.

Experience indicates that traffic signals are effective in reducing certain types of accidents, especially right-angle collisions, but they may not reducee other types such as rear-end collisions and certain accidents involving turns. Signals which seem to be unnecessary are also likely to be violated at times with resulting accidents.

Poor Design.—There are still quite a number of signals in use which are poorly designed. For example, one electric light bulb may be used to illuminate four lenses of a signal suspended over the intersection. This may sound like good economy, but it results in very ineffective signal indications. Practically all modern signals have a lamp and effective reflector behind each signal lens.

Or the signal may be so designed that light from one lamp leaks out and partially illuminates a lens which is not supposed to be lighted. Another case is where there are inadequate visors so that at certain times the sunlight makes it look as though more than one lens were illuminated. This is particularly true when too weak a lamp is used.

Poorly Located.—Many a signal is a nuisance because it is so located that the driver is pretty much forced to guess which of two signal indications he should obey. This fault is especially true with signals located in the center of an intersection—particularly if the intersection is irregular in shape with acute angles between two or more of the streets.

Sometimes a signal is located way out of the normal line of vision of the approaching vehicle driver.

As far as pedestrians are concerned, there are many signalized intersections at which the signal faces are so located that the pedestrian is confused as to which one he should obey.

Wrongly Operated.—Quite often, where a signal is warranted, it is a nuisance because the operation is so faulty. There are many signals at which the red and green lights stay on for too long a time. Long periods are generally a nuisance because of the excessive delay which they involve. At a great many signals the time is not divided up so as to meet satisfactorily the needs of traffic on the intersecting streets. For example, a street on which vehicles move two abreast in each direction may be given just as much time as the intersecting street with an equal amount of traffic but only one moving lane in each direction.

Another example of wrong operation is a non-standard operation; that is, one where somebody's "pet" idea is being worked out, but in such a way that the average driver doesn't understand what he is supposed to do at various times. Here is a good example: A driver approaching a certain intersection sees a regular green indication ahead. He notices that the curb lane is unoccupied, so he pulls into that space, intending to proceed straight ahead. Just as he gets close to the intersection the light changes. He stops. A driver behind him honks his horn. The first driver then notices, for the first time, a sign which indicates that at this intersection you are supposed to turn right only on the red light with the green arrow. But he doesn't want to turn right so he waits while several cars pull up behind him and honk angrily for him to move.

Another example of wrong operation involving design is an intersection of three streets where the volume of

traffic varies greatly at different hours of the day. In many cases this is operated with intervals of predetermined fixed length. Traffic is tied up seriously many times a day. Such a location should be operated by traffic-actuated equipment with which the number of vehicles approaching on the various streets determines the length of the various intervals—and these intervals vary widely as traffic demands change.

Yet one more example of wrong operation for fixed-time control is where a signal continues on Stop and Go operation late at night when it should be changed to flashing operation—for example, flashing red for the equivalent of a stop sign on the minor street, and a flashing cautionary yellow on the major street.

Another nuisance condition involving faulty operation is encountered when you drive down a street having signals at a number of adjacent intersections. Practically every signal changes to red as you get to it. The fault is that such conditions warrant "tying together" the operation of these signals on a carefully worked out basis so that the signals will change to green as you approach successive intersections.

You approach a signal with a red light showing in your direction. You pull up and stop. The light continues red; you wait; it is still red; the longer you wait the madder you get, yet the light stays red. Why? The controller is "stuck"—usually because of lack of proper maintenance. Or, take the case where you approach an unfamiliar intersection and, seeing no signal light, go right ahead through. Just as you are half way through, a driver comes tearing in from the other street and you narrowly avoid a collision. You stop and look around, and sure enough there is a green light showing on the other street—but your signal was out because of a bulb failure. Where maintenance is poor, this condition is likely to be encountered at many intersections. It is more than a nuisance, it is a serious hazard.

Another case is where the sun is fairly low in the west and as you approach the signal you cannot tell which lens is illuminated. Exasperated, you determine to find out why. You park your car and walk back to the signal. Looking up, you see that the lens is very dirty. If you could climb up and open the door, you might find that the reflector was not only dirty but badly blackened. Another hazardous nuisance condition resulting from poor maintenance.

Yet "Good" Signals Are Valuable.—"Well," you may say, "that is a mighty big list of objectionable features. I am beginning to wonder how useful traffic signals are anyway!" We all know, however, that good signals are very valuable traffic control devices. They can reduce accidents; bring about orderly movement at busy and hitherto congested intersections; they can reduce delays; and they can reduce the cost of control very materially as compared to officer control—although at some intersections, turning movements or other complications make officer control the only proper solution.

Good signals must first be warranted or needed, and the need must be definitely established—and not be a matter of guess work. They must be properly designed and installed. They must be operated so as satisfactorily to meet the traffic needs at the intersection. They must be effectively maintained.

Good signal systems can accomplish all the above stated results and can, in addition, govern the speed of movement to one which is safe for the street and for existing conditions. They can also provide for reasonably continuous movement along an artery.

How to Avoid Nuisance Signals.—The problem, then, is how to avoid objectionable signals and conversely how to determine *where* signals should be installed, *how* they should be installed, and *how* they should be operated and mantained.

This is largely an engineering problem and though many engineers haven't yet realized it, it is none too simple a job either. Practically every signalization problem is one which, if effectively done, will challenge the intelligence and ingenuity of a good engineer.

"I Am Interested, But What Can I Do About It?"—"Yes, I will agree that there is an engineering job to be done if proper results are to be achieved from signals, but I don't know anything about it. I would have to have a lot of guidance if I were to undertake to determine in my community where signals should be installed, how they should be operated, and so on."

It is true that the study of the appropriate design, installation, and operation of signals involves many factors. In the first place, *facts* must be secured as a basis for decision about signalization. One needs to know how many vehicles are passing through the intersection at various times of day, and how variable the flow is. Street car operation must often be studied if the signals are to be effective in their operation for frequently the street car lanes are the "critical" lanes on the street. The left turns must often be given especial consideration. Accidents need to be carefully studied as to how they happen and whether the types which occur most frequently would be helped by signals or, as is sometimes true, increased thereby.

But you may say, "Supposing I did make these various counts and studies, how would I know whether the facts warranted a signal or not, and how would I know how to time such a signal if it were warranted? Or, if a signal system seemed the proper solution, how would I find out how to design it? I would need some 'measuring sticks' or guides if I were to attempt this job."

New Manual On Uniform Traffic Control Devices Furnishes Specific Warrants and Much Other Helpful Information.—For several years a committee made up of representatives of the National Conference on Street and Highway Safety and of the American Association of State Highway Officials, has been working to develop a Manual which would help the engineer in his signal problems (and also in problems concerning the use of Signs, Markings and Islands).

Last May the Fourth National Conference on Street and Highway Safety met in Washington and specialists from all over the country considered the recommendations of this Manual. Certain changes were voted. With the changes, the Manual was approved. The American Association of State Highway Officials has likewise approved the Manual in its revised form.

Just How Will This Manual Help the Engineer With His Signal Problems?—Part III of this Manual deals with signals. Let's consider what it covers. Here are some of the more important subjects:

Importance of standardization.

The value of signals.

Classification of signals as between Stop and Go, train control, and flashing signals.

A further classification as between fixed-time signals which are operated by mechanism on a predetermined time schedule that may be varied under certain conditions; and

Traffic-actuated signals which are actuated by approaching traffic by means of mechanical or electrical devices.

A discussion of why signals are installed.

A list of *specific* warrants or "measuring sticks" as a basis for decision as to whether a signal is or is not warranted. These warrants include the following:

(a) minimum vehicular volume
(b) heavy left turn
(c) minimum pedestrian volume
(d) coordinated movement
(e) through highway
(f) accident hazard
(g) combination of warrants; and other factors

These warrants give definite "measuring sticks" such as a minimum of a thousand vehicle per hour for an intersection of the ordinary type. They are discussed both for fixed-time signals and traffic-actuated signals.

There are then presented definite suggestions as to what types of control mechanism should be selected for various conditions.

Article 3 deals extensively with the major features of signal design, including the number of lenses per signal face, color and position of lenses, illumination, visibility, etc.

Article 4 deals in detail with the problems of where signal faces should be located at an intersection, recommending, for example, signal faces on each of the four corners as the standard, and discussing the number of signal faces per corner.

Article 5 deals with installation, shielding of signals so that the driver won't be confused between two signal faces showing opposite indications, etc.

Article 6 is entitled "Operation" and explains such matters as meanings of color indications, use of turning arrows and special WALK lens, length of cycle, when to use flashing operation, how to help pedestrians, different methods of "tying together" signals into a coordinated system with advantages and disadvantages of the various systems.

Article 7 is entitled "Maintenance." This sets up recommended standard practices as to inspection, bulb replacement, cleaning, over-hauling of controllers, etc.

References are made to various reports which will suggest to the engineer specific methods of securing the various data necessary for effective signalization.

The subjects are presented in considerable detail—the Manual representing what is believed to be the most comprehensive treatment of this subject available under one cover.

Furthermore, this committee stands ready and offers its services in assisting any engineer who decides to engage in this type of work and encounters problems in which he desires further information or suggestions.

Manual Also Covers Traffic Signs, Markings, and Islands.—The Signals Section is only one of four parts of this Manual. The proper design, installation and use of traffic signs, markings and islands are likewise matters which cannot be handled satisfactorily in a haphazard fashion. We can all remember traffic signs which had so many words on them in such small letters that one couldn't possibly read them without stopping. Yet they were supposed to warn traffic which was passing at speeds of 30 miles per hour or more.

We have all seen signs which "cry wolf" by greatly over-emphasizing a hazard ahead. The worst of it is that after we have encountered a few of these unwarranted signs we are apt to get the impression that all such signs are largely unnecessary. So, when we do come to a place where the sign is really needed, we don't comply with it as completely as we should, and an accident or near accident may result.

Engineers should decide where traffic signs, markings and islands are needed and what kinds are needed. They should then control the design, installation and maintenance. They should determine what signs need to be illuminated at night or where reflector buttons should be installed to give adequate warning after dark. They should be governed by standard and reasonable warrants or "measuring sticks" as to the use of such traffic control devices. All these matters are covered very completely in the new Manual.

Importance of Engineering In Traffic Control.—Only a relatively small amount of thoughtful consideration will convince the logical person that a large part of the traffic control job involves an important engineering technique. The recent Fourth National Conference gave very complete recognition to this fact.

In a very helpful general report entitled "Guides to Traffic Safety," one of the major sections deals with the many ways in which engineering must be introduced into the effective control of our serious and growing traffic problem.

Another section of the report entitled "Administration" brings out the importance of the factual approach to the problem and gives an important place to the engineer in this picture. Numerous of the research subjects suggested in the report involve the engineering approach. Even in the other parts of this recommendation-packed document, there are many activities in which the engineer can be of very valuable service.

Traffic Engineers Recommended.—While any competent engineer can be of valuable assistance in meeting the traffic control problems of his community or state, there is sufficient work in all the larger cities and in each state for an engineer to specialize exclusively in traffic problems. Such engineers are called "Traffic Engineers" and already some 24,000,000 people live in cities having traffic engineering service. Several states also have State Traffic Engineers, including Massachusetts, New Jersey, Ohio, Oregon and Tennessee.

The Fourth National Conference on Street and Highway Safety recommended traffic engineers for states and municipalities. Such recommendations are included in the report "Guides to Traffic Safety." Also, the new Model Municipal Traffic Regulations include specific recommendations for the setting up of a traffic engineering agency and set forth powers and duties for such a position.

How to Secure These Documents.—"Guides to Traffic Safety" has already been printed. The other documents referred to are now being printed. Any engineer desiring to secure any or all of these should write to Mr. A. W. Koehler, Secretary, National Conference on Street and Highway Safety, 1615 H Street, N. W., Washington, D. C.

Traffic Engineering Advances in the Past Year.—A professional Institute of Traffic Engineers, organized four years ago, has been growing steadily and now includes in its membership most of the leading traffic engineers in the country. This organization has the following purposes:

"The objects of the Institute shall be the advancement of the art and science of traffic engineering, the fostering of traffic engineering education, the stimulation of original research in traffic engineering, the professional improvement of its members, the encouragement of intercourse between men with mutual interests in traffic engi-

neering, and the establishment of a central point of reference and union for its members."

It holds an annual meeting and publishes its proceedings. The annual meeting this year will be held at the Hotel Cleveland, Cleveland, Ohio, Oct. 2 and 3.

There are several grades of membership, including an affiliate membership suitable for engineers interested in specializing in this work, but without any considerable experience in it. The standards of the organization are of a high professional character.

During the past year numerous traffic surveys have been made or are being made. Many of them are using unemployed workers under the Federal Emergency Relief Administration, with competent engineers as survey directors. A quite thorough Traffic Survey Manual has been developed for the guidance of engineers who lack detailed experience in this specialized field.

Improvements in traffic signal technique are being made from year to year. Two recent examples are the unique plan for coordination of signals on the parkway in Philadelphia, and the new coordinated system planned for Michigan Boulevard in Chicago. Further information may be secured by addressing Mr. T. M. Matson, Traffic Engineer Bureau of Engineering, Surveys and Zoning, City Hall Annex, Philadelphia, Pa.; and Mr. Leslie J. Sorenson, City Traffic Engineer, Department of Public Works, Chicago.

Traffic engineers are constantly seeking ways and means of reducing the cost of traffic control. Last year's report of this committee mentioned a number of specific illustrations. As an example of recent progress, a new testing method has been devised to tell which traffic paints will wear the longest. This is an accelerated test and enables officials to buy good paints which will last many times as long as cheap paints which cost practically as much.

Throughout the country, traffic engineers have been assisting in enforcement, education, and in devising improvements in the organization and administration of the traffic problem in their states or communities.

Many improvements have been made in methods of using accident records—a most important field of study if effective results are to be secured in reducing accidents.

Acknowledgment—The foregoing is the report of the Committee on Traffic Control of the American Society of Municipal Engineers, presented Sept. 24 at the annual convention at Rochester, N. Y. Burton W. Marsh, Director Safety and Traffic Engineering Department, American Automobile Association, is chairman of the committee.

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Twenty Public Works Specialists Aid N. Y. U. Engineering Courses

Twenty prominent engineers, public officials and economists will participate this year in the presentation of a new curriculum in the New York University College of Engineering, designed especially to train undergraduate and graduate engineers for careers in public works and the construction industry. Planned and arranged by Professor Thorndike Saville, recently appointed by the Federal Administration to direct a national survey of water resources, the new course is believed to be unique in colleges of engineering.

The new curriculum, outlined by Dr. Saville, will include five courses: public-works principles and practices, construction codes and labor problems, industrial organization, engineering economics and finance, and constructors' organization and equipment. Several of the present specialized senior studies will be eliminated or condensed to make room for the new courses.

Common Sense in Transportation

We have several times used the phrase "Competition will eventually make over our railroads into a cheaper and far more efficient transportation machine." We are convinced that such modernization will be the eventual solution of our transportation problem. Government regulation, attempted co-ordination, railway czars, programs for the strangulation of competition may retard the process, but cannot successfully withstand the economic pressure.

Railway development has followed natural lines, although the evolution has not been rapid enough to satisfy congress, nor the shipping public, for that matter. Having somewhat overbuilt a system sufficiently superior to drive practically all competition from inland waterways and highways, the railways proceeded to produce abuses inherent in a nation-wide monopoly. Government regulation followed. Resisted by the railways at first, it was later accepted as a comfortable shelter behind which a standard and interlocking fabric of fares, rates, and schedules was constructed, supposedly designed to produce maximum earnings with a minimum of effort.

The carriers did not recognize it, but this static state was rather the first stage of senility. The traveler who remarked that the only innovation introduced by the railways in two generations was a slot for used razor blades in Pullman washrooms had some basis for his criticism. At any rate, commerce resented the attempt to restrict its markets and the old forms of competition by highway and waterway returned with new vigor and vastly improved equipment. Railway response was the cry of the defeatist—"Regulate our competitors." But public support has not been forthcoming. Neither highway nor waterway transportation has any record of the monopolistic abuse that is the background of railway regulation.

But a minority of railway thought preferred action to inaction, and their plans to do something about it by "making over" their facilities are commencing to materialize. As usual, the first steps were directed toward a rejuvenation of passenger service, and air conditioned trains made their appearance. Added comforts, however, would not attract the bus rider or the motorist, so lines in the south and southwest sharply reduced passenger fares. The development of lightweight, streamlined, motor driven trains or single units to cut operating costs was a natural sequence. Revolutionary changes in freight service were next initiated. Door to door service was offered. The speed of freight trains was increased and the latest proposal is to clear away the intricate and troublesome freight classification, with its archaic distinctions, and offer equal door to door service for anything the public may wish to ship.

The future is beginning to clear and our legislators at the next session of congress should hesitate before offering comfort or support to any bill involving the extension of regulation, co-ordination, public operation, or what not. Not only transportation, but the restoration of commerce, and with it prosperity, are at stake.—Editorial in the *Chicago Daily Tribune*.

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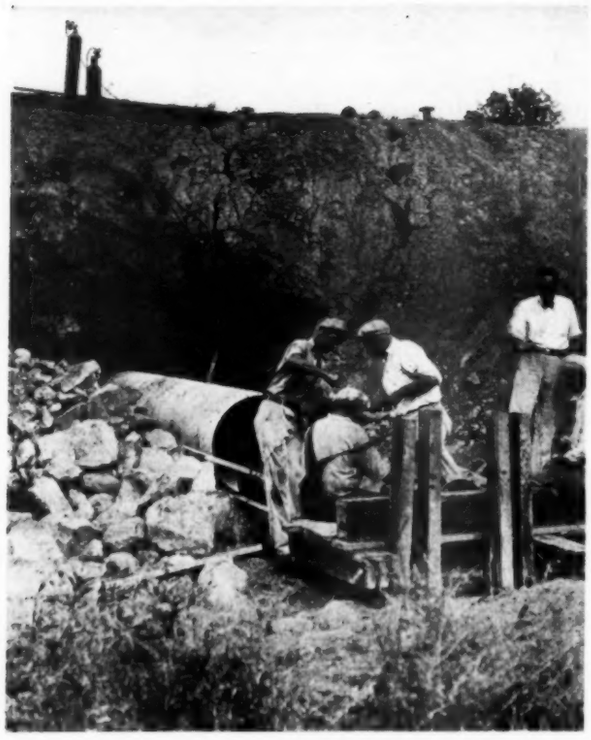
Motor Vehicle Registrations in 1933—The total registration of motor cars, busses and trucks in 1933 was 23,827,290, compared with 24,115,129 in 1932, a decrease of 1.19 per cent. Of the total registration last year passenger vehicles, cars and busses accounted for 20,600,545, and freight vehicles, trucks and tractors for 3,226,747.

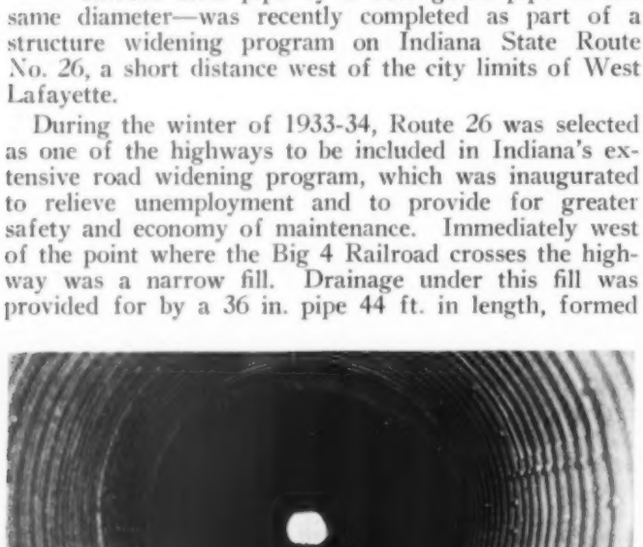


Backstop, Lining Timbers and Other Details of the Jacking Set-Up

BOILER PLATE PIPE CULVERT REPLACED BY JACKING METHOD

AN unusual application of the jacking method of installing culverts and conduits—replacing a smooth steel pipe by a corrugated pipe of the same diameter—was recently completed as part of a structure widening program on Indiana State Route No. 26, a short distance west of the city limits of West Lafayette.

During the winter of 1933-34, Route 26 was selected as one of the highways to be included in Indiana's extensive road widening program, which was inaugurated to relieve unemployment and to provide for greater safety and economy of maintenance. Immediately west of the point where the Big 4 Railroad crosses the highway was a narrow fill. Drainage under this fill was provided for by a 36 in. pipe 44 ft. in length, formed of ¼ in. thick boiler plates. To permit the fill to be widened to the desired width this structure was extended by 30 ft. of 36 in. corrugated iron pipe at the time the additional fill was made.



How the New Pipe Replaced the Old as the Latter Was Cut Into Pieces and Removed

In the spring of 1934 when plans were being made to extend the drainage structures to conform to the widened grade, the old boiler plate pipe was inspected and found to be in the following condition: Deterioration in the bottom of the pipe had progressed to such an extent that in portions the metal, Bessemer steel, had completely rusted away. The top showed very little loss of metal. As the pipe was installed on a fairly steep grade, this condition was attributed to a combination of the effects corrosion and erosion which had been acting on the unprotected, black plates during the 30 odd years the pipe had been in service. Because of this condition, it was decided to replace the old pipe by corrugated pipe, the same material which had been used previously to extend it.

Methods Considered for Replacement.—At first, threading the new pipe into the old was considered as a possible means of making the replacement. However, because of a slight deflection in the existing pipe, this would necessitate reducing the effective waterway area which was undesirable so this plan was abandoned.

Replacing the pipe by the open trench method would have required digging a trench 17 ft. in depth. Because of the nature of the fill, sheeting would have been required for a narrow trench, or without sheeting a cut with a top width of 30 ft. would have been necessary. In either case a portion of the retread pavement laid in the early summer of 1934 would have been destroyed and a period of maintenance for settling fill would have

been necessary. To avoid these very obvious disadvantages an alternate plan was proposed by a representative of the W. Q. O'Neall Company, the manufacturer supplying the pipe. This plan called for cutting the old pipe by means of a burning torch so that sections of from 3 to 4 ft. in length could be removed. As the old pipe was removed in this manner, the new pipe would be jacked into place. By repeating this process it was thought that the replacement could be effected without expensive excavation or without destroying the pavement and its attendant maintenance and it was decided to follow this plan.

The first step in carrying out the plan was the removal of a monolithic extension 6 ft. in length at the downstream end of the old pipe, which was done by blasting. Lining timbers, composed of 2 in. by 4 in. set on a line and grade conforming to that of the old pipe were next set in place. A backstop of I-beams placed 4 ft. in the ground and backed up by railroad ties was built for the jacks to operate against.

The Jacking Operations.—After a portion of the old pipe had been removed a 20-ft. section of the new pipe was rolled on to the lining timbers and pushed into place. When another section of the old pipe, cut into three pieces, was removed the new pipe was advanced to within a few inches of the old pipe. This process was repeated until the entire section was forced into the embankment. A new section was then added by a field riveted joint and in this manner the entire 44 ft. of pipe required to replace the old pipe was forced into place. Connection with extensions installed previously was made by an inside connecting band developed for this special purpose.

Work was started on Monday P. M. and completed by Thursday P. M. with the expenditure of 100 man hours, including supervision. Two tanks of gas and four tanks of oxygen, costing $30.16, were required for cutting the old pipe into sections small enough to be removed. Compared to this outlay for the jacking method, open trenching without sheeting would have required the excavation and subsequent backfilling of 275 cu. yd. of material plus the maintenance required for a settling fill and the expense of replacing the road surface.

While replacing failed or failing drainage structures by jacking a pipe of larger diameter around them is nothing new, to date it has been confined to rigid structures which could be broken and removed. And, as stated at the beginning of this article the application of the jacking method as above described is an innovation. The ease and economy with which it was applied in this case plus the added advantage of no interruption to traffic promises a wider use of this method in replacing metal pipe under high fills and high type, heavily traveled pavements. With a pipe of less wall thickness, greater speed and lower costs could be obtained than on this job, as cutting and removing the plates, which were originally ¼ in. in thickness, was the item requiring the greatest amount of labor and expense.

This job was completed by S. S. Palma of Lafayette, Ind., who was awarded the contract for the structure widening on this project. The actual jacking was carried on under the direction of A. M. Snyder, sales engineer, and Leslie Davidson, foreman for the W. Q. O'Neall Company of Crawfordsville, Ind.

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AMERICAN INSTITUTE OF STEEL CONSTRUCTION TO MEET IN CHICAGO—The 12th annual convention of the American Institute of Steel Construction will be held Oct. 25 and 26 at the Edgewater Beach Hotel, Chicago, Ill. V. G. Iden, 200 Madison Ave., New York, is acting secretary.

Origin of the Term "Super-Highway"

J. P. Hallihan, Chief Engineer, Rapid Transit Commission, Detroit, Mich., in a paper in the August Proceedings of the American Society of Civil Engineers states that as far as is known from the records, the term, "super-highway," was coined by Daniel L. Turner, to describe a single-level, all-purpose highway designed to provide an exclusive right of way for rail transit in combination with superior facilities for movement of heavy-volume motor traffic created in metropolitan areas.

The design was applied by Mr. Turner as the keynote of his plan for a co-ordinated thoroughfare system within the developed section of Detroit, Mich., and its expansion into a regional plan for the Metropolitan Area, later adopted as the Master Plan for Detroit and the three counties affected.

The purpose of the design may be best described by a brief condensation from Mr. Turner's report as Consulting Engineer to the Rapid Transit Commission, dated April 10, 1924:

The specifications provide for: (1) A central reservation of 84 ft. for the exclusive use of rapid transit lines on rails and the tree and shrub planting to screen it; (2) a 20-ft. roadway for express motor traffic on each side of the central space; (3) a 5-ft. planting or safety zone strip, on the outside of the express roadway, separating express from local roadways, but with openings at intervals for transfer from local to express where the roadways are at the same level between stations; (4) local roadways, 20 ft. wide; and (5) sidewalks, 15 ft. wide, making a total of 204 ft.

After acquisition of the right of way, the execution of the design is intended to be coincident with the local requirements of the area and, therefore, will proceed gradually as building development progresses and traffic needs increase. At first, all roadways will be at the same level and cross-street traffic will cross the rail reservation at all street intersections. The express roadways will be provided when the central reservation is ocuupied by rapid transit rails and the right of way is made exclusive by separation of grades at half-mile intervals at stations, the rails and express roadways going over the half depressed cross-street and the local roadways meeting the cross-street at grade. Cross-traffic coming in between stations may then turn into the local roadway, but may cross the express roadway and rail reservation only at the under-pass. Traffic from local roadways may enter the express roadway at the barrier opening provided where local and express roadways are at the same level. Grade separations may be built for express roadways in advance of rail occupancy of the central reservation if traffic needs require, under the same limitations as to crossing.

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$7,000,000 HIGHWAY PROPOSED IN ARGENTINA—The National Highway Bureau of Argentina in conjunction with the Ministry of Public Works of the Province of Buenos Aires have practically completed plans for the projected paved highway between Buenos Aires and Mar del Plate, the leading Argentine tourist resort on the Atlantic Coast. The road will be about 250 miles in length and it is estimated to cost about $7,000,000. The cost will be borne jointly by the Province of Buenos Aires and the Federal Government through federal aid. About 26 miles will be surfaced with concrete and the rest with bituminous macadam and will have a width of about 19.6 feet on the paved portion.

NEW YORK STATE'S EXPERIENCES WITH LOW COST BITUMINOUS TOPS

By DAVID NOONAN

Assistant Commissioner of Highways, New York State Department of Public Works, Albany, N. Y.

CERTAIN broad factors determine the feasibility of using any given variety of road surfacing aggregate, such factors being the amount and kind of traffic, together with the climatic and topographical conditions. Other factors of lesser importance are appearance, color, etc., since it is now easily possible to produce any desired characteristic of smoothness, skidproof texture, color and appearance with any of the standard paving materials. Therefore, the principal considerations are those first mentioned, the local conditions and the traffic which the road will have to carry. The volume of traffic determines the amount of money which can be profitably expended to achieve the desired condition of the surface and any real study of the road situation must come to this consideration in the final analysis. No system of roads ever can be developed for the country as a whole, with the benefits of the improvement extended to every village and farm, unless "ability to pay" is taken into account.

The availability of local materials is of prime importance in the selection of type inasmuch as local materials if properly used and controlled in many localities will result in the saving of huge sums. Much money has been wasted in the importing of materials when local materials could have been used with excellent results.

In treating of this subject, I will confine my remarks to bituminous tops and assume that the foundation and drainage is adequate to properly support the top and wearing surface.

Penetration Bituminous Macadam (Hot).—In the construction of a bituminous macadam pavement by the penetration method our practice calls for a top course made up wholly of No. 3 stone spread to such a depth that will produce a 3 in. compacted thickness. No. 3 stone, according to our specifications, is stone that is retained on a 1 in. square aperture and passes through a 2¼ in. square aperture of screen. This insures an open top into which the bituminous material can penetrate. After this stone is spread and completely compacted by rolling with a 10-ton self-propeller roller, the bituminous material heated to 300° F. is spread over the surface with a pressure distributor mounted on a motor truck capable of producing a pressure of 50 lb. per square inch. Two gallons per square yard of bituminous material "A" is used in this first application. The surface is immediately covered with No. 1 stone to comply with our specifications which require a size of stone which will pass through a ⅝ in. square aperture and be retained on a ¼ in. square aperture of screen. This stone must be dry and absolutely free of dust. The surface is again rolled and the surplus No. 1 stone is broomed off the pavement.

Before placing the seal coat the surface is tested with a 16 ft. straight edge laid parallel with the center line of the pavement and any variation from the true profile exceeding ¼ in. must be eliminated or the pavement relaid.

A seal coat of bituminous material "A" consisting of ¾ gal. per square yard is then applied by means of a distributor the same as described above. The pavement is then covered with No. 1 stone and the rolling operation is continued. During the rolling operation the stone should be broomed to obtain a smooth and uniform surface.

Weather permitting, not more than 24 hours should elapse between the application of the No. 1 stone and seal coat of bituminous material, but in no case should traffic be allowed on the pavement between the first application and the seal coat. Approximately ¼ in. of No. 1 stone is spread uniformly over the entire pavement to serve as a wearing coat.

Approximate cost of this type of top course complete is 60 ct. per square yard.

Broken stone should be of the best quality obtainable within the limits of economy and should be clean, dry, durable, sharp, angular fragments of rock, uniform in quality and free from thin or elongated particles. Disintegrated stone or other objectionable materials should be eliminated. The stone when tested according to the standards of the A.S.T.M. should indicate a percentage of wear of not more than 5.7.

ITEM 64-P—SPECIFICATION FOR BITUMINOUS MATERIAL "A" PENETRATION METHOD

This material shall have the following characteristics:

1. It shall be free from water.
2. The various hydrocarbons composing it shall be present in a homogeneous solution.
3. It shall have a specific gravity at 77° F. of not less than 0.99

4. Bituminous material shipped before October 1st shall have a penetration (77° F., 100 g., 5 sec.) of not less than 100 nor more than 110. Bituminous material shipped after October 1st shall have a penetration (77° F., 100 g., 5 sec.) of not less than 110 nor more than 120.
5. It shall have an oven evaporation loss of less than 4%. The penetration (77° F., 100 g., 5 sec.) of this residue shall be at least 50% of the original penetration.
6. Its solubility at air temperature in carbon disulphide, for the following named products, shall be at least 99.5% for pure bitumen products, 95% of Bermudez products, 81% for Cuban products and 66% for Trinidad products.
7. It shall show an open flash point not less than 375° F.
8. It shall show a toughness at 32° F. not less than 15 cm. Toughness is determined by breaking a cylinder of the material 1¼ inches in diameter by 1¼ inches in height in a Page impact machine (A. S. T. M., 1908). The first drop of the hammer being from a height of 5 cm. and each succeeding blow increased by 5 cm.
9. It shall have a ductility at 77° F. of not less than 60 cm. (Dow mold).

Penetration Bituminous Macadam (Cold).—This type of bituminous macadam penetration is quite similar to the preceding with the following exceptions:

Emulsified asphalt is used as a binder. A layer of No. 3 stone approximately 4 in. in depth is spread loose upon the foundation or bottom course. This course is then consolidated by the use of a 10-ton roller after which an application of No. 2 stone is evenly spread over the surface and serves to fill the voids and choke the surface. No. 2 stone is retained on a ⅝ in. square aperture and passes a 1 in. square aperture of screen. A light rolling serves to complete the chinking of this material into the coarse aggregate after which the material shall be thoroughly wet with water but without excess. While the stone is still wet approximately 1¼ gal. per square yard of Bituminous Material "A" Emulsion Type 3 at air temperature is applied evenly over the surface by means of a distributor such as outlined above, operating under a minimum pressure of 20 lb. per square inch.

Immediately after the emulsion has been applied and before it has had time to "break" No. 1 stone is spread over the surface and rolled. The quantity of stone applied is only sufficient to permit rolling without "picking up" and if necessary, the roller wheels may be wet with water to assist in preventing displacement.

A second application of emulsion is then made at the rate of 0.9 gal. per square yard immediately covered with No. 1 stone chips in sufficient quantity to fill all interstices without excess, and rolling is then continued. The surface shall then be thoroughly broomed to insure even distribution of the stone chips, adding more No. 1 stone, if necessary, to give a uniform cover. The following day the pavement shall be thoroughly and systematically rolled beginning at the haunches and finishing at the crown, and the pavement shall then be opened to traffic for three or four days before placing the seal coat.

Before placing the seal coat the pavement should be tested in the same manner as outlined above for Penetration Bituminous Macadam (Hot).

Seal Coat: After all of the inequalities in the surface have been removed and the pavement subject to traffic three or four days, the surface should be cleaned of all excess stone, dirt, dust or foreign matter and a seal coat of ½ gal. of asphalt emulsion is applied per square yard in the same manner as above. Immediately before the emulsion has a chance to "break" it is uniformly covered with clean No. 1 size stone and thoroughly rolled. During the rolling operation the surface should be broomed and more No. 1 stone added wherever necessary to give a uniform covering with slight excess.

Care must be exercised when this type of construction is indulged in due to the fact that emulsion is "tricky" material and subject to "breaking." Speed is essential due to the rapidity with which the material may set up. However, where this type of construction is used an extremely smooth riding surface is obtained due to the fact that it can be back rolled the day after the material has been laid. One of the big advantages in the use of emulsion is that the material does not require heating. The approximate cost of this type of pavement is 60 ct. per square yard complete.

ITEM 70-B—SPECIFICATIONS FOR BITUMINOUS MATERIAL "A" EMULSION (TYPE 3)

Bidders on asphaltic emulsion shall submit on request a sample of the emulsion, taken by an inspector, from a factory lot of material of not less than 20,000 gallons. The samples so submitted shall meet the requirements of the following specifications:

The emulsion shall be homogeneous.

Any material accepted at the time of shipment, which should prove to be defective within 30 days after date of delivery will not be accepted or paid for by the Division and will remain the property of the contractor, except when separation has been caused by freezing.

Settlement—Not over 3% in 5 days.

The specific gravity, at 77° F., of the emulsion shall not be less than 1.00.

The ash of the emulsion shall not be over 2.0%.

The emulsion shall have an oven evaporation loss (10 g., 325° F., 5 hrs.) of not less than 40 nor more than 45%.

A 100 gram sample of the emulsion shall have a demulsibility of at least 50% break when treated with 35 cc. of N/50 calcium chloride solution.

Screen test (Emul. Ind. Meth.)—Not more than 0.10%.

The viscosity shall be such that the material will flow readily from a distributor.

The asphalt used in the emulsion shall have the following characteristics:

a. Specific gravity at 77° F. of not less than 1.00.

b. Penetration at 77° F., 100 grams, 5 seconds 125 to 225. (See Note.)

c. Its solubility at air temperature in carbon disulphide shall be not less than 97.0%.

d. It shall have a ductility at 77° F. of at lest 60 cm.

NOTES—When the bitumen is recovered by distillation (A. S. T. M. D-244-28T) the penetration shall be between 125 and 175.

The oil in the distillate shall not be over 2.0%.

The settlement test may be waived at the option of the purchaser.

Retread or Road Mix—I appeared before the Canadian Good Roads Association at Hamilton, Ont., last year and presented a paper on "Road Mixed Types of Pavement," commonly called "Retread."

The State of New York is continuing the use of this type of construction. However, we have experimented successfully with the use of a pre-mixed seal coat or surface veneer in place of the seal coat described in the paper of last year. To describe this type of pavement would be a repetition of the paper of last year except for the modification which we are now using.

We have had excellent results by using approximately 50 lbs. per square yard of Type 3 Bituminous Macadam Mixing Method (Amiesite). This material is substituted for the final seal coat of bituminous material and cover referred to in my paper of last year. It produces a more dense surface which is non-skid and will not require surface treatment for a considerable number of years. On the regular retread or road mix, surface treatments may be required within a couple of years after the pavement is completed. I am unable to present actual cost data at this time, but I am of the opinion that the cost would be only slightly in excess of the cost for regular road mix.

Our cost per square yard for regular road mix during 1932 was 41.9 ct. per square yard for pavement only. During 1933 we constructed 278 miles of this type. The average cost of bituminous material per square yard was 14.1 ct.; the average cost of the stone per square yard was 20.9 ct. and the average cost per square yard of labor on pavement only was 4.9 ct. making a total cost per square yard of pavement 39.9 ct.

The bituminous materials used for this type of construction were set forth in the paper of last year and have not been modified.

Pre-Mixed—Of the pre-mixed types of macadam pavement we have secured the best results with Bituminous Macadam, Mixing Method, Type 3. In laying of this type of pavement we use two different sizes of coated stone—one known as a coarse mix and the other a fine mix—as outlined and described in detail in the specifications below. The specifications indicate the percentages, size and kind of each material used, including broken stone, naphtha, asphalt cement, hydrated lime and mineral aggregate.

We plan on using a depth of loose material which will provide for a minimum consolidated thickness of 1½ in. of the coarse mix which is laid first upon the prepared bottom or foundation course after which this course is thoroughly consolidated by the use of an 8-ton tamden roller. Then the fine mix is evenly spread over the pavement to produce a finished consolidated thickness of the fine mix of ½ in.

You will note from the specifications that all mixtures, including the asphalt material, are proportioned by weight using an approved, accurate calibrated scale.

In the manufacture of this material only clean, thoroughly dry materials, free from lumps, should be used. The mixing time in the pugmill is specified at not less than 3½ minutes. To facilitate the spreading and consolidation of the materials in the pavement motor truck delivery direct from the plant is preferable to railroad car shipments as the material has a tendency to consolidate in railroad cars, and in cool weather many difficulties are encountered in the removal of this material from railroad cars and the manipulation of it on the road.

We advocate and have written in the specifications that all Type 3 material should be laid with an approved type of black top paver. In the use of Type 3 material where a machine is used, one-way traffic can be maintained with little inconvenience to the travelling public and the rapidity with which the material can be laid and the perfect contour attained cannot be approached by hand work and the cost is almost negligible. An incident that was brought forcibly to my attention between Binghamton and Windsor in the state of New York, 350 tons of material were laid in an eight hour working day requiring only three laborers in the spreading operation.

ITEM 53—TOP COURSE BITUMINOUS MACADAM MIXING METHOD, TYPE 3

a. WORK. Under this item the contractor shall construct a mixed bituminous macadam laid to conform to the required grade and cross section and of the thickness shown on the plans.

b. FORMS. The forms of this work shall be of wood of an improved type and a minimum length of 10 feet for tangents and curves, unless otherwise shown on the plans. All forms shall be straight, free from bends and warps at all times and shall be cleaned thoroughly and oiled before pavement is placed against them; this cleaning and oiling being repeated daily as the forms are moved ahead. The forms shall rest firmly upon the thoroughly compacted subgrade throughout their entire length, shall be joined neatly and tightly and staked securely to line and grade at least 200 feet in advance of the point of placing pavement by using at least 3 bracing pins or stakes to each 10 foot length of side form, so that they will resist the pressure of the pavement and the impact of the roller without springing.

2. MATERIAL AND PREPARATION OF MIXTURE. The formula used for preparing the asphalt paving mixture shall be set to proportion them to the best advantage from the materials hereinafter specified, but not to exceed the following limitations:

Materials	Coarse Mix %	Fine Mix %
Broken rock	87.0 to 93.0	83.0 to 90.0
Naphtha (a) or (b)	.4 to 1.0	.4 to 1.0
Asphalt cement	3.0 to 5.0	5.0 to 8.0
Hydrated lime	.5 to 1.0	.5 to 1.0
Fine aggregate	3.0 to 6.0	5.0 to 9.0

Broken rock for the coarse mix shall have the following gradation:

	%
No. 2 size	80 to 100
No. 1 size	0 to 20

Broken rock for the fine mix shall have the following gradation:

	%
No. 1 size	55 to 85
No. 1A size	15 to 45

The broken rock shall be passed through a rotating cylindrical drier. It shall be heated by hot gases, not by direct flame, to a temperature sufficient to drive off all of the moisture so that as it comes from the drier it will have neither surface nor contained moisture. Broken rock leaving the drier at a temperature greater than 110° F. shall be stored in stock piles and entirely protected from the weather until the temperature reaches that specified. In no case shall the temperature of the broken rock be less than 50° F. No hot stone shall be placed in a storage pile or bin while other materials are being used from it. After it has cooled to the temperature specified, it shall be screened and placed in covered bins with three or four compartments and of a capacity ample to insure production schedules.

NAPHTHA. The naphtha shall meet one of the following requirements, as determined by the engineer, and the amount used shall in every instance be greater than that which can be absorbed by the surfaces of the mineral aggregate.

(a) Light naphtha shall be a petroleum distillate which when distilled in accordance with A. S. T. M. D. 86-30 shall have an initial boiling point of not over 220° F., and an end point of not over 450° F. At least 45% of the distillate shall be distilled over at 325° F.

(b) Heavy naphtha shall be a petroleum distillate which when in accordance with A. S. T. M. D. 86-30 shall have an initial boiling point of not over 150° F., and an end point of not over 525° F. When 50% of the distillate has distilled over the temperature shall be between 290° F. and 360° F. The flash point of the heavy naphtha shall be below 80° F.

Light naphtha shall be used in all cases unless shown on the plans or ordered in writing by the Deputy Commissioner.

ASPHALT CEMENT shall meet the requirements of Item 64.

HYDRATED LIME shall meet the requirements of the American Society for Testing Materials.

FINE AGGREGATE shall be clean crushed rock screenings 100% of which will pass a ⅛ inch screen.

TOP DRESSING. If required a top course of clean sand or grit, 90% of which will pass a 14 mesh laboratory sieve and 75% of which will be retained on a 48 mesh sieve, shall be uniformly spread on the finished pavement, at the rate of approximately 6 to 8 pounds per sq. yard of pavement, within 24 hours after the fine mix has been placed and rolled.

PROPORTIONING. All mixtures, including the asphalt, shall be proportioned by weight, using approved accurate calibrated scale which shall, at all times, be in good operating condition. The scales shall be protected against wind, vibration, etc., and be so placed as to be readily visible. (The amount of hydrated lime for each batch may be measured by volume on the basis of a volume weight relation.)

MIXING. The materials specified above, in the proportions determined by the engineer, shall be introduced into each batch and combined as hereafter set forth. All aggregates shall be clean, thoroughly dry and free from lumps. The total mixing time shall not be less than three and one-half minutes.

The mineral aggregate, at a temperature specified, weighed out separately to the quantity specified, shall be placed in a twin-pug mill and agitated until thoroughly mixed.

The naphtha, measured in a calibrated device to provide the exact quantity specified, shall then be sprayed into the mixer and the mixing continued until the mass is thoroughly covered.

The asphalt cement, weighed in a distributing bucket attached to a special scale, equipped for the rapid adjustments of tare, shall be poured into the mixture at a temperature between 250° F. and 300° F., and the mixing continued until the mass presents a uniform black color. The hydrated lime carefully weighed or measured, shall be deposited in the mixer in a uniform manner and the churning continued until the whitened mass has attained its former lustre.

TRANSPORTING. Rail shipments shall be made in cars free from dirt, cinders, or other foreign matter, and it shall be so loaded into tight vehicles, carts, wagons or trucks, previously cleaned of all foreign material, and delivered to the work, that it will not become contaminated in any way.

d. INSPECTION. APPROVAL OF SOURCES OF MATERIAL SUPPLY. Sources of supply for the asphalt cement and mineral aggregate shall be approved by the Department before the delivery of the materials is started and shall be submitted in accordance with the requirements of the Department.

PLANT INSPECTION. Equipment, materials and the preparation of mixture shall be subject to inspection and approval at the refineries and plant as may be directed.

Surface Treatments—Surface treatment work in general is confined to the treatment of concrete pavements and bituminous bound macadam pavements using the following kinds of bituminous material: Light Cold and Hot Tars, Bituminous Material "A" Emulsion Type 3, such as referred to above, and Carpet Asphalt.

The use of light cold tar is confined to the treatment of portland cement concrete, gravel and open or porous bituminous macadam pavements that permit of penetration. We believe in the treatment of portland cement concrete pavements which has started to scale on the surface and is somewhat porous, a light prime coat of cold tar is preferable due to its penetrating quality, about 0.2 gal. per square yard being used, and lightly covered with stone chips.

ITEM 74—SPECIFICATION FOR BITUMINOUS MATERIAL "T" SURFACE TREATMENT

This material shall have the following characteristics:

	Min.	Max.
1. Water, per cent by volume	....	2.0
2. Specific gravity 25/25° C	1.10	....
3. Specific viscosity, Engler 50 cc. at 40° C	8.0	35.
4. Total bitumen (soluble in carbon disulphide %)	88.0	....
5. Total distillate by weight (water free):		
To 170° C	....	5.0
To 270° C	....	30.0
To 300° C	....	40.0
(a) Softening point of residue from distillation test ° C. (R & B)	35.0	65.0

NOTE: The following limits shall be used:

For priming	Sp. Visc. 8-13
For light surface treatment	Sp. Visc. 13-18
For heavy surface treatment, or honing	Sp. Visc. 18-25
For mulch honing	Sp. Visc. 25-35

Subsequent treatments of concrete pavements that have been primed are made by the use of hot tar using about 0.3 gal. per square yard and lightly covered with No. 2 stone. This produces a non-skid surface.

Our records indicate that the cost of surface treatment using tar as outlined above is approximately 4 ct. per square yard, which price includes the cost of the bituminous material, the stone chips for cover and the labor of applying both of the above materials.

ITEM 73-A—SPECIFICATION FOR BITUMINOUS MATERIAL "T" MIXED-IN-PLACE, HOT WEATHER OR HOT APPLICATION

This material shall have the following characteristics:

	Min.	Max.
1. It shall be homogeneous and free from water.		
2. Specific gravity 25/25° C	1.14	....
3. Float test at 32° C. sec	60	210
4. Total bitumen (soluble in carbon disulphide %)	78	....
5. Total distillate by weight (water free):		
To 170° C. %		1.0
To 270° C. %		15.0
To 300° C. %		25.0
(a) Softening point of residue from distillation test ° C. (R & B)	45	70

NOTE: The following limits shall be used:
Float test at 32° C. 60-150 (cool weather).
Float test at 32° C. 150-210 (hot weather).

Asphaltic Emulsion Type 3, the same specification as indicated above for Item 70-B, is used for surface treating on mottled surfaces of bituminous macadam pavements to seal the surface, using ¼ gal. per square yard lightly covered with No. 1 stone chips. Care must be used in applying the stone chips directly behind the distributor in order to insure the chips being locked into the bituminous material before it breaks. This material is applied at air temperature.

Our records indicate that the cost of surface treatment using Asphaltic Emulsion Type 3 as outlined above, is approximately 5 ct. per square yard, which price includes the cost of the bituminous material, the stone chips for cover and the labor of applying both of the above materials.

We have also used a material which we refer to as Carpet Asphalt. This is a blend of 75 per cent by volume of Bituminous Material Penetration Asphalt and 25 per cent of Bituminous Material "A" Cut-Back. The purposes of using this material is to produce a non-skid surface on a pavement that has become slick through bleeding or too frequent surface treatments. Approximately 0.45 gal. per square yard of this material is used and covered with No. 2 size stone chips preferably of an extremely hard character. In order to distribute this bituminous material on the surface it is necessary to heat the same and this requires great care due to the fact that the solvent used is inflammable and explosive when confined.

Our records indicate that the cost of surface treatment using carpet asphalt, as outlined above, is approximately 6 ct. per square yard, which price includes the cost of the bituminous material, the stone chips for cover and the labor of applying both of the above materials.

ITEM 64-R—SPECIFICATION FOR BITUMINOUS MATERIAL "A" CARPET ASPHALT

This material shall have the following characteristics:

1. It shall be free from water.
2. The various hydrocarbons composing it shall be present in a homogeneous solution.
3. When distilled (A. S. T. M., D. 20-30) up to a temperature of 450° F., the total distillate shall not be less than 8 nor more than 14% by volume. The initial boiling point of the distillate shall not be over 275° F., and at least 20% shall be distilled over at 325° F. The residue, poured from the flask immediately after the distillation, shall have the following characteristics:
   (a) It shall have a specific gravity at 77° F. of not less than 0.99.
   (b) It shall have a penetration (77° F., 100 g., 5 sec.) of not less than 60 nor more than 120.
   (c) Its solubility at air temperature in carbon disulphide shall be at least 99.5%.
   (d) It shall have a ductility at 77° F. of not less than 60 cm. (Dow mold).

On all surface treatments we advocate rolling of the cover coat immediately after the application of the stone chips.

With the use of emulsion, hot tar and carpet asphalt there is but little inconvenience to the traveling public due to the fact that the bituminous material and cover set up quickly and does not throw or displace under traffic. Cold tar when chipped and rolled causes but little inconvenience to the traveling public.

This is a phase of maintenance work that in past years always caused considerable annoyance to the traveling public and was the cause of a great many severe criticisms of the Department. We attempt now to get this work completed prior to May 30th which in the State of New York starts the heavy touring season. In the surface treatment of any type of pavement stone chips should be used as a cover for the bitumen and pea gravel or sand should not be used due to the practical impossibility of holding the cover material on the surface and on the other hand, stone chips produce a more durable wearing surface.

Low cost roads have been assumed to mean low first cost only. This is an erroneous assumption. The cost of any type of pavement should not only include the first cost but also the maintenance as well as the vehicular operating cost.

Acknowledgment—The foregoing is an abstract of a paper prepared for presentation at the annual Convention of the Canadian Good Roads Association at Murray Bay, Quebec, September 13.

IMPROVED ARROWS FOR HIGHWAY SIGNS

By C. C. WILEY
Associate Professor of Highway Engineering, University of Illinois, Urbana, Ill.

THE increase in automobile speeds combined with the greater amount of night driving has made it imperative that all types of road signs be made more effective for both day and night use. This is especially true of arrows since an arrow indicates a definite movement of the car and failure to deliver the message to the driver at the proper time may result in disaster.

The arrow devised by the American Association of State Highway Officials, conveniently termed the ASHO arrow, is perhaps most generally used. This arrow is defective, however, in that the head is too narrow for the shaft and the barbs recede with acute points. The result is that the head is soon lost to view even to the normal eye. A superior form of arrow is that devised by the Illinois Highway Department a number of years ago and freely used on Illinois roads. Its head is triangular in shape with the length slightly greater than the width. By daylight the head is distinctly visible to the normal eye at a distance about 50 per cent greater than that of an ASHO arrow with same size of shaft. The ASHO arrow, therefore, is only about 65 per cent as effective as the Illinois arrow. These two types of

Fig. 3

Fig. 4

arrows of the same basic size and photographed from the same distance are shown in Figs. 1 and 5.

Many signs are now reflectorized for greater effectiveness at night. The general practice with regard to arrows is to place the reflector buttons entirely within the outline. The result is the head relatively smaller by night than by day. At even a short distance the head merges with the shaft so that there appears only a single bar of light, possibly a little more brilliant at the head end, especially with white buttons. Even this effect is lost at greater distances.

During some recent experiments on highway signs by Mr. D. M. Baldwin, graduate student in civil engineering at the University of Illinois under the direction of the writer, the device of placing the buttons outside the head in the form of a V was tried. The results were so satisfactory that two experimental arrows were made

Fig. 1

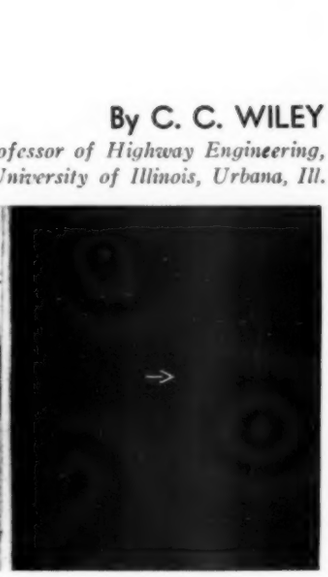

Fig. 2

and placed on Illinois Route 10 at a bad turn. By day the buttons do not detract from the visibility of the regular arrow although they are visible at short distances as shown in Fig. 1. At night the effect is that of a shaft with a distinct V head as shown in Fig. 2. The separate buttons are visible at a distance of some 200 ft., but the whole appears as a distinct arrow at distances of 500 to 600 ft. Questionnaires were sent to a number of people habitually using this road. The answers were unanimous in the conclusion that this scheme of reflectorizing is vastly superior to the conventional type with the buttons within the head.

The Illinois Division has recently adapted the outside location of the buttons to the standard ASHO arrow and is installing such signs on the U. S. Routes. Figures 5 and 6 are views of one of these signs in place on U. S. 45. Many comments of approval of these signs have come from automobile drivers.

The accompanying figures are day and night photographs of three signs illustrating the shape of the arrows and the methods of reflectorizing. They are all taken

Fig. 5

Fig. 6

from a distance of 60 ft. and, therefore, show the relative characteristics of the different signs. Figures 1 and 2 show one of the experimental arrows. Figures 3 and 4 show a standard ASHO reverse curve sign with the reflector buttons inside the head. Figures 5 and 6 show one of the new Illinois modifications of the standard ASHO curve sign with buttons located outside the arrow head.

Despite the greater difficulty of photographing the black and yellow sign as compared with the black and white sign these views indicate the daylight superiority of the Illinois arrow over the ASHO arrow. The night views distinctly reveal the marked superiority of the outside location of buttons over the inside arrangement. The driver is quickly impressed with the improvement since the arrow in Fig. 6 is distinct at 2 to 3 times the distance at which the arrow in Fig. 4 can be clearly seen. The arrow in Fig. 2 is sharp at still greater distances.

The outside arrangement of the button can easily be adapted to either new or old signs. The Illinois arrow is simpler than the ASHO type and can easily replace other type on plain signs when repainted although it may be difficult to do so on embossed signs. It is equally adaptable to new signs whether plain or embossed. The advantages of both devices can, therefore, be easily obtained at little or no additional cost and the benefits to traffic are many.

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Concrete Pumped to Place in Construction of Elevated Highway

An interesting paving job is now in progress on the new West Side elevated highway leading out of New York City. The work now under construction extends from 38th to 46th St., New York. A temporary ramp has been built to the 46th St. end, which will be removed on completion of the section from 46th to 59th St.

The roadway consists of two 30-ft. sections separated by a raised center area 3 ft. 8 in. wide. The out to out width of each section between girders, including sidewalks, is 34 ft. Longitudinal distance between expansion joints, located at bent supports, is 87 ft.

The total thickness of the deck pavement is 13 in., consisting of 7¾ in. of concrete covered with 4 in. granite block. Four ply waterproofing is first placed on the concrete. On this is placed a 1-in. layer of sand. The granite block are then placed in this cushion.

The feature of this job is the method being used for transporting the concrete. Ready mixed concrete is

Pumpcrete Outfit at Work on West Side Elevated Highway.

Concrete Delivered by 6-in. Pipe Line to Point of Depositing on Deck Structure.

delivered by the Transit Mix Concrete Corporation in 5 cu. yd. truck mixers. From these truck mixers the concrete is dumped into Rex Pumpcrete equipment, which transports the concrete by pipe for distances as great as 500 ft., plus a vertical rise from the equipment at street level to the deck of the structure.

A 6-in. pipe line is used and pipe sections are added or removed as necessary to obtain delivery at the point desired. An average of 200 cu. yd. per day has been handled.

A 1:2:4 concrete mix is being used, with a water ratio of approximately 7 gal. per sack of cement. This gives a slump of between 5½ and 6 in., although no difficulty would be experienced with a lower slump in transporting through the Pumpcrete equipment.

Poirier and McLane Corp., New York, has the contract for this work. John O'Rourke is construction engineer. J. E. L. Ryan is assistant construction engineer. Dr. F. Kleeberg is testing engineer. R. Harrington is section engineer.

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How State Aid Started

The principle of taxing urban units for the development of country roads originated in New Jersey, according to a paper by George H. Herrold, Managing Director and Engineer, The City Planning Board of St. Paul, Minn., in the August Proceedings of the American Society of Civil Engineers. Mr. Herrold stated that in 1785 the Continental Congress established the township system orginated in New England, and made it applicable to all Government-owned land. The State then adopted or created the section-line highway of 2, 3, or 4 rods in width, to make the lands accessible and to permit their development. This was practically the highway system of the United States—a rectangular system. The easement to the road being by prescription, the abutting owners, in turn, had access to the road at all points of contact for trade and barter of the products of the land. Originally, the township paid for the construction of the roads on the section and quarter-section lines; then, some one in New Jersey applied the "scientific method." By observation on a certain stretch of road, he found not only local township wagons, but wagons from adjoining townships and from townships far beyond. He reached the conclusion and was able to convince the Legislature that the State should contribute. The first legislative act was to require that the abutting property owner pay one-tenth of the cost, the State one-third, and the county the remainder.

EDITORIALS

The Railways As a Sad Object Lesson

TWENTY-EIGHT years ago the Interstate Commerce Commission was authorized by congress to regulate the rates charged by railways. The ball opened with "the Spokane rate case." The writer was then chief engineer of the Washington Railroad Commission, and testified as an expert in that case. At that time, and for many years afterward, he believed that railway rate regulation by commissions would be so satisfactory both to the public and to the owners of railway securities that government ownership would cease to be a possibility. But for at least 15 years it has been evident that unless the Interstate Commerce Commission were to make radical changes in its policies, the railways would probably become such poor investments that new capital would almost cease to flow into them, thus leading to government ownership. The depression that started in 1929 has only served to render more probable such an outcome.

Business men who seek to escape the severities of competition by submitting to governmental control will find in railway history of the last 28 years an object lesson that may be profitably studied. They will see how beaurocrats constantly seek to increase their authority over a business that they "regulate," and how eventually they secure what they seek.

Having ruined nearly all the railways financially, the railway bureaucrats now seek to "rescue" them by imposing their regulatory policies upon competing forms of transportation. The result will be no rescue for the railways, and it will spell disaster for highway transportation companies.

Relatively few newspaper editors have opposed the proposed extensions of regulatory powers of the Interstate Commerce Commission. Notable among the few are the editors of the Chicago Daily Tribune and the Chicago Daily News. The editorial article from The Tribune appears on page 369 of this issue. In our November issue a similar article from The Daily News will be reprinted.

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Continued Attacks of Railways Upon Trucks and Buses

IN many states railway interests are organizing "citizen transportation leagues" and the like, whose object it is to bring about legislation that will cripple motor-truck and bus transportation. For example, the Washington Railroad Employers' Ship-By-Rail Association urges every railway employee to solicit membership in a league that will put an end to "special highway privilege." Since members in the league will not have to pay dues, it is evident that railways will finance the proposed propaganda of the league. "More railway jobs are in sight—if we fight," says the president of the aforesaid railroad employees' association, forgetting to mention that fewer jobs for trucks and buses are in sight if success crowns the efforts of the railways.

We have repeatedly shown that our public highways are self-supporting by virtue of gasoline taxes and license fees. Our figures have never been contested by any railway official, but many a railway official continues to assert that the railways, as taxpayers, have furnished much of the capital for building roads. It is interesting to read how many different public uses they find that railway taxes are put to. They would have the public believe that railway taxes almost pay for local government and schooling besides, yet still leave enough to build roads to compete with railroads! This sort of argument will not carry much weight with well informed legislators, and railway officials seem to sense as much when it is urged upon railway employees to: "Do your part and we'll have 150,000 Washington voters enlisted in this fight in no time! The legislature will pay attention to one hundred and fifty thousand votes!" The last six words are set in capitals, indicating the reliance upon votes rather than on facts.

J. J. Pelley, President of the N. Y., N. H. and H. R. R., has publicly advocated that motor vehicle owners pay high enough taxes to cover all annual expenditures for new construction as well as maintenance. Had that been the economic policy as to railways, there would be few railways in America. He knows very well that annual interest charges and dividends on the capital invested, and not the capital annually expended, is the proper basis for railway rates, yet he favors an entirely different and unsound economic policy for highway rates of charge. He would have annual highway charges suffice to return the annual investment in improved highways in the same year that the investment is made! We repeat that America would have few railways had such an absurd policy prevailed as to them.

Be fair, Mr. Pelley, even if your company is financially distressed. We sympathize with that distress. The solution of your problem does not lie in stifling competition, but in meeting it as intelligently as Ford met his, which was vastly more severe than your railway has ever experienced.

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14% of Motor Vehicle Fees Diverted

IN our August issue we called attention to the drastic diversion in 1933 of the revenue from the gasoline tax to other than highway purposes. The same thing happened to the funds collected by the state for the registration of motor vehicles. Of the total receipts last year of $392,691,035 from registration fees, $44,123,358 was diverted. Of the 1933 gasoline tax, $55,742,173 was used for other than highway purposes, thus making a total diversion of nearly $100,000,000 from the revenue collected specifically for road construction and maintenance and other expenses connected therewith. Twenty-two of the states diverted some of their funds from registration fees, New York being the principal offender, by transferring $20,796,585 to the state general fund. The state of Florida received $4,994,882 from motor vehicle registration fees and applied $4,599,158 of this to the county school fund. The rich state of Pennsylvania used $4,042,235 as a payment on state debt obligations. Other states diverted their receipts to such purposes as relief aid to cities and towns, to state motor police, to state employees retirement fund and the many and varied uses that politicians could devise.

COUNTY AND TOWNSHIP ROADS

A Section Devoted to Those Interested **In Secondary Road Improvement**

One of the Higher Types of Construction Used on the Rural Road System of Pennsylvania

LOW COST ROAD CONSTRUCTION IN PENNSYLVANIA

By SAMUEL ECKELS

Chief Engineer, Pennsylvania Department of Highways

IN August, 1931, the Pennsylvania State Highway System was increased by the addition of 20,170 miles of rural routes, 15,491 miles of which were classified as unimproved. Of the 4,679 miles classified as improved, 1,609 miles required reclamation work to secure a condition satisfactory for maintenance.

In August, 1933, the rural system was expanded by the fillings in of 655 miles of borough street gaps including 235 unimproved miles.

Without releasing any responsibility for the previously existing system of 13,640 miles, the complete maintenance of these new routes was assumed and their hard surfacing, so as to furnish all-weather pavements, was promised to be accomplished as rapidly as funds would permit.

All of this would be paid for from the motor fund without imposing any additional or increased imposts on motor vehicles, liquid fuels, etc.

This extensive program enhanced the importance of highway economics and made it absolutely necessary to conserve funds to the fullest practical extent. The highest engineering standards consistent with the traffic requirements, however, were followed. Low cost but adequate surveys and plans were provided and the field forces were required to give proper consideration to such fundamentals as alignment, grades, width, drainage character, and depth of base, type of surface and superelevation.

In planning the work, care was taken to gain full advantage of availability of local materials and consideration was given to the foundation value of various soils on which the surface was to be laid. At the same time types of surfaces and methods of construction were selected to provide a maximum use of common labor in order to assist efforts being made to relieve unemployment.

Types of Construction.—Of the various types of construction those most generally used included oilbound, penetration, premixed materials, or heavy surface treatments on native stone, slag, "red dog," flint, gravel, or commercial stone bases, but a knapped native stone base with an oilbound top has been preferred where its construction has been practical.

The construction has principally been by department forces with generally two and sometimes three shifts of labor. It has been carefully supervised in accordance with up-to-date specifications in which, on account of

Crew Sledging Native Stone Base Course in Place

the methods of construction and the character of traffic of these routes, the quantities of oil and chips were increased over the amounts of former standards.

"Oilbound" roads of a 2-in. depth had been constructed for several years in our state and many miles of this type were authorized and constructed in 1931 following specifications which had been in operation at that time.

Either asphalt "cut back" or tar was permitted and used with good results. Crushed stone with the following grading requirements was the only aggregate permitted:

	Min.	Max.
Passing 1½-in. screen, per cent....	100	
Passing 1¼-in. screen, per cent....	85	100
Passing ⅝-in. screen, per cent....	10	40
Passing ⅜-in. screen, per cent....	0	8

The spreading of the aggregate was permitted by any method which would secure proper depth, width, and distribution without segregation, and rolling before applying bituminous material was insisted upon to secure a firm, even surface, true to grade and cross-section.

After the stone had been prepared properly, the application of bituminous material and finishing were specified as follows:

Application of Bituminous Material.—No bituminous material shall be applied unless the entire surface course is thoroughly dry, and in no case shall the bituminous material be applied when conditions do not permit satisfactory penetration and adhesion. Any of the surface course stone which has become coated or mixed with dirt or foreign substances shall be removed and replaced with clean stone.

After the stone has been thoroughly rolled there shall be spread over the surface from five-tenths (0.5) to seventy-five hundredths (0.75) gallons per square yard of bituminous material in two applications. The first application shall be approximately three-tenths (0.3) to four-tenths (0.4) gallons per square yard, after which the surface shall be rolled with a ten (10) ton roller to a uniform cross-section and allowed to dry from twenty-four (24) to thirty-six (36) hours. The second application of bituminous material shall be made at the rate of two-tenths (0.2) to thirty-five hundredths (0.35) gallons per square yard, depending upon the appearance of the first application. Where the surface presents a dull brown color, it will be necessary to apply a larger amount of the bituminous material than where an ample amount of bituminous material shows on the surface from the previous application. After the last application the rolling shall continue until the surface is thoroughly compacted.

The bituminous material shall be spread evenly in both applications by an approved pressure distributor. The length of the road surface penetrated with bituminous material shall be gauged by the facilities for handling dependent upon labor and equipment on the project, so as to obtain proper compression and spreading.

Finishing.—When the surface is completed it shall be tested with standard template and straight edges. Any irregularities of more than one-quarter (¼) of an inch shall be remedied to the satisfaction of the engineer by loosening the surface and removing or adding stone and bituminous material as may be required and rolling continued until it is compacted satisfactorily to a uniform surface. The contractor shall not haul heavy loads over the completed surface and any damage caused by contractor shall be repaired satisfactorily at his own expense. Ashes and cinders from fire boxes shall not be dumped on the surface.

Preventing Ravelling.—Approximately 0.80 to 0.85 gal. of bituminous material per square yard was used in this earlier construction and it became evident immediately that ravelling occurred due to the "open" surface of the completed product. In order to eliminate this condition, a "seal coat" of 0.25 gal. of bituminous material per square yard, covered with 25 lbs. of stone chips per square yard of the following grading, was added to the requirements:

	Min.	Max.
Passing ⅝-in. screen, per cent.....	100	
Passing ¼-in. screen, per cent.....	0	20
Passing ⅛-in. screen, per cent.....	0	10

This seal coat was placed within a few days or a week after the penetration material was applied and manipulated. The standard practice then followed was the application of 0.5 gal. per square yard, followed the next day with 0.25 gal. per square yard, after which the surface was rolled thoroughly and after correcting uneven places and rerolling the patched areas so that

Preliminary Work on Improvement of Earth Road

the entire surface was compacted thoroughly, the road was open to traffic and the seal coat applied as outlined above. These same methods were utilized also during the entire year of 1932. While the ravelling decreased by these improved methods, the amount of patching required in the spring months and the necessity of applying another seal coat or retreatment of 0.25 gal. of bituminous material and 25 lbs. of stone chips as a covering material, the season after the road was constructed, convinced us that there was something definitely wrong, either with our materials or methods. In 1933, asphalt of slightly softer consistency and of slower drying qualities was specified and this effected a most decided improvement, but the surfaces were not as tightly sealed as contemplated, and it was not possible to retain all of the chips on the seal coat. After considerable experimenting, the amount of bituminous material was increased to 1.25 gal. per square yard for the same amount of stone as used previously, and the work was performed as outlined in the new specifications, known as Pennsylvania P. M. 2 (Revised April 20, 1934), which, including the specifications for the bituminous materials, are as follows:

The size of stone used remains the same as the original specification, but a slightly larger amount of chips is specified in order to secure a tightly sealed surface. Rolling of the stone, prior to application of oil is optional with the engineer, but experience has shown that rolling should not be performed at that time as it interferes with proper penetration. On practically all work of this type, asphalt cut back, Pennsylvania Specifications C-1 and C-2 have been used. On a very large mileage C-1 has been used as the penetration material and C-2 as the seal coat. This combination has been most effective and satisfactory. On a normal job 1.00 gal. per square yard of C-1, and 0.25 gal. of C-2 have proved to be sufficient for the purpose required. Tar has been used on several projects, also with good results.

How the Average Project Is Constructed.—Controlled by the specifications, and supplementing them with the latest approved practices, an average project of this type is constructed as follows:

After the stone has been placed, it should be levelled by a power grader, and then further brought to a true grade and cross-section by a multiple blade drag drawn by a truck or power grader. Bituminous material should then be applied at the rate of 0.50 gal. per square yard. After this application, the entire surface should be thoroughly dragged with the multiple blade drag, which mixes the stone and bituminous material, as well as provides a true surface. After this dragging, a further application of 0.25 gal. per square yard should be placed. As soon as the material has set sufficiently, the entire surface should be rolled, in the proper manner, with a 3-wheel, 10-ton power roller until the surface is compacted thoroughly. The surface should then be checked for irregularities and depressions with straight edge and crown board and all corrections made, removing the high spots and patching depressions with pre-mixed materials. The corrected areas should again be rolled until a uniformly compacted surface is secured. After this operation, approximately 15 to 20 lbs. of Pennsylvania 1B-stone chips should be applied to the surface, which shall be rolled into the surface with the roller equipped with multiple brooms attached to back of roller to secure even distribution. The edges of the pavement should be watched carefully to insure proper chinking. C-1 bituminous material, at the rate of 0.25 gal. per square yard, should again be applied and rolling resumed, after which the road should be then thrown open to traffic for a period of three or four weeks. The road is then again checked for irregularities and after correcting, the final seal coat is applied by placing approximately 10 to 15 lbs. of Pennsylvania 1B chips on the surface and the rolling operation resumed as outlined above. C-2 bituminous material, at the rate of 0.25 gal. per square yard, is then applied on top of the chips and rolling again resumed until the pavement is compacted thoroughly and presents a dense, water-tight appearance. The roller wheels should be treated with a mixture of 50 per cent kerosene and 50 per cent water to prevent picking up of the surface.

One of the Higher Types of Surfaces on the Rural Road System of Pennsylvania

An Improved Road on the Pennsylvania Rural System

Advantages of Methods Summarized.—To summarize the advantages of the above methods, we consider the first application of the bituminous material of 0.50 gal. per square yard as a binding agent through penetration and partial mixing, by the use of the multiple blade drag. The second application of 0.25 gal. per square yard also penetrates and covers portions of stone missed by first application. The rolling operation at this stage of the procedure binds the stone together so that it will withstand traffic. The first application of stone chips at this point fills the voids between the stone and the next application of bituminous material of 0.25 gal. per square

yard penetrates to a certain extent and acts as a partial seal coat. Road surfaces, in this condition have been utilized by traffic for more than six weeks with no damage or ravelling of the surface. The next application of stone chips fills the remaining voids in the surface and by holding the last application of bituminous material up to the surface insures a real seal to the pavement surface. The finished appearance of the surface is very similar to cold mixed asphaltic concrete. The patching of the surface to remove irregularities before coats are applied insures a uniform appearance to the final product in which the patches, if any, cannot be detected. Hundreds of miles of this type of pavement were constructed in Pennsylvania in 1933, and where there were no base or drainage difficulties, it has not been necessary to perform any patching whatever, since they were constructed. This is true in the face of the hardest winter Pennsylvania has experienced in many years. Surface treatment was not necessary this year. Due to improved methods of placing stone chips, these chips become thoroughly imbedded in the surface and none are lost along the side of the road. Local communities in Pennsylvania are following these specifications and methods with good results.

Costs.—These are representative costs of oilbound (PM-2) top computed from the records of one of our engineering districts.

County	Cost Per Sq. Yd.
Berks	$0.32
Carbon	.368
Lehigh	.31
Monroe	.38
Northampton	.29
Schuylkill	.364
Average	$0.335

Newly Developed Type.—A newly developed type of construction, particularly applicable to localities where there is available stone of a quality suitable for base but not top courses, is the native stone base with heavy surface treatment. The methods with approximate quantities and costs are as follows:

Field stone is spread on the prepared subgrade in quantities to secure required depth, generally 6 to 8 inches, and are knapped in place to proper cross-section at 30 ct. a square yard. The interstices are chinked with gravel, shale or cinders at 11 ct. a square yard. A layer of ¾-in. surfacing quality stone is next spread at 9 ct. a square yard and there is a surface treatment of 1 gal. of oil and 25 lbs. of chips a square yard. The total cost of the pavement is about 63 ct. a square yard.

The various types of bituminous surface roads, adequate for their traffic demands, have been built at total costs ranging generally from $6,000 to $9,000 a mile and they are being maintained at very reasonable expense.

In planning the annual construction programs the routes of greatest traffic importance have been given precedence and a number of them as they have been completed have been shown on our tourist maps, as cut-offs or by-passes.

The new routes have greatly benefited the rural residents of a large portion of the area of the state. Together with the mileage of the old system it is estimated that 90 per cent of the state's population is served by hard surface roads, greatly increasing the facilities for highway users and relieving traffic congestion on many primary routes.

Acknowledgment.—The foregoing is a paper presented Sept. 25 at the Congress of Public Works and Municipal Engineering at Rochester, N. Y.

1935 Meeting of American Road Builders to Be in Washington

The American Road Builders' Association will hold its 1935 convention and highway exhibit in Washington, January 22-25, inclusive, as announced by Captain H. C. Whitehurst, President of the association and Director of Highways of the District of Columbia. Convention headquarters will be at the Willard Hotel.

An adequate highway program based upon securing financial aid through federal and states sources, giving especial attention to the use of highway revenues for highway purposes and principally the non-diversion of the gasoline taxes and motor license revenues for purposes other than highway construction and maintenance will be the theme of the convention. Methods of extending recently passed federal legislation into the many states will be given careful consideration.

This convention and exhibit will be of particular interest because highway construction has had such an important part in the national recovery program. It is recognized as a capital investment and is an activity which puts more men to work in a shorter time than any other. The convention will bring together thousands of the leading highway officials, engineers, contractors, equipment distributors, producers and manufacturers from all parts of the country for the purpose of discussing ways and means of continuing an adequate highway program.

A number of prominent men who are playing an important part in the continuation of the highway program will take part in the convention proceedings. At the annual banquet the future outline of the federal and state highway program will be presented by a speaker of national reputation, it is announced.

The divisions of the American Road Builders' Association which will meet at the time of the Convention are: County Highway Officials, City Officials, Contractors, Highway Equipment and Manufacturers, and the Engineers and Officials, the latter membership including representatives from more than 40 state highway departments.

Since its inception the American Road Builders' Association has taken the leadership in the "cause of good roads." It has conducted exhaustive studies on highway finance, administration, safety, construction and maintenance, and these studies are used by members of the association and other city, county and state highway officials, contractors, distributors and manufacturers throughout the world, as well as many colleges and universities.

In selecting Washington as the location for the 1935 convention and exhibit it was felt that inasmuch as federal and State legislation will play such an important part in continuing the highway program in the next few years, that the proceedings of the convention from the national capital will have a far reaching effect. This is especially true since congress and forty or more state legislatures will be in session at the time of our convention.

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MINNESOTA FAST ELIMINATING CENTER ROAD PIERS —Dangerous center piers where highways pass underneath railroad tracks will soon be almost eliminated from Minnesota's 11,000 mile trunk road system. When work now under contract or definitely included in the current construction program has been completed, only five center piers will remain on trunk routes.

Bowesville Road, Bowesville, Ont., on Feb. 28, 1934

SNOW CONTROL AND TREATMENT OF ICY SURFACES IN ONTARIO

By JOHN SEARS

Resident Engineer, Department of Highways, Ontario, Ottawa, Ont.

HAVE many of you considered the great difference between maintaining our highways during the open summer season and during the winter? It is comparatively simple to estimate costs for keeping the highways in good condition during the spring, summer and fall, but there has yet to arise in our land a prophet who will forecast the number of snow and sleet storms within even reasonable limits. This means that the work, to be effective, must be planned and organized to take care of the worst conditions, not the anticipated average conditions.

The extremes to which conditions vary may be forcibly brought home when it is pointed out that snow removal costs for the Ottawa district for the winter season 1933-34 were approximately six times as great as those of 1932-33. You will no doubt agree with me that owing to these variable conditions we must have available reserves of equipment and materials to insure that our highways, as planned, are kept open and safe for traffic under any conditions that may arise. In these days a blockage of our highways, especially adjacent to the larger centers, may result in serious losses.

Light and Heavy Equipment Considered.—There has been considerable discussion in recent years as to the respective merits of light and heavy equipment in the clearing of snow from our highways. From my own observations and experience in the Ottawa district, during the last eight years, I would suggest a change in our organization and equipment, which would apply to any other district where a heavy snow fall might be anticipated.

The proposal I have in mind would be the equipping of Patrolmen's trucks with either light V-type or straight blade plows and this light equipment would be supplemented by a large rotary unit, located at a central point. This latter equipment would necessarily have to have not only enough reserve power to tackle any snow conditions that might obtain, but would also have to be capable of carrying out the heavier work it would be called upon to perform at a comparatively high rate of speed, in order to cover the long mileage of the district.

I am not directly acquainted with the type of rotary plow unit I have in mind but there is, I understand, on the market one which will fulfil the requirements of doing the heaviest work with speed and despatch. While it is realized that this new plow assembly means a rather large financial outlay, and might only be used during the winter months, it is pointed out that the employing of this plant in conjunction with the patrolmen trucks, equipped with blades or V-plows, should practically eliminate the hiring of contractors' trucks.

Change in Trucks Proposed.—The adoption of this proposal would involve a change in the type of trucks supplied by the department of highways, Ontario, for patrol work. At present a light 1½ ton truck is employed, which would hardly be suitable for use in snow clearing. For this work, a 2 to 2½ ton truck, with heavy rear end assembly, would probably be necessary.

While the replacement of present type trucks with heavier trucks would involve an increase in capital expenditure and operating expenses during the summer months, the year round results obtained by this change, it is considered, would more than justify the added expenditure.

Patrol Beat 30 Miles in Length.—Enlarging on this proposed plan, it is presumed that a patrol beat would average in length 30 miles, with the patrolman located at or near the center of same. With a snow storm or heavy drifting conditions starting, the patrolman's small snow plowing unit would immediately go into action and if necessary would work 24 hours, with a change in crew every eight hours. Even under severe storm conditions a rugged little unit of this kind should be able to keep a comparatively short section of 30 miles clear at all times, providing of course that the centrally located heavy rotary unit makes periodical trips to remove the snow pushed to the side of roadway by the patrol trucks.

The adoption of a plan or policy for snow clearing is extremely important and should be settled definitely not later than the middle of October. The wardens of the counties, or other responsible authorities, should be consulted as to whether the provincial highway leading

through their districts should be cleared for motor and truck traffic or only maintained for sleigh traffic. With this information to hand, designations of sections of roads to be cleared can be adopted and the winter campaign intelligently planned.

Schedule Necessary.—You can readily understand how important it is that we should adhere strictly to the adopted schedule, when I tell you that in past years we have been called upon to clear outlying roads not on the original schedule, roads which had been plugged with snow and ice for two or three weeks. This often meant, owing to the heavy work involved, breakdowns in plowing equipment, which might be badly needed shortly for the clearing of our regular designated roads.

In recent years, our department has generally planned a schedule of clearing only those highways where the traffic would warrant the expenditure. With the increasing demand for this service I believe that the scope of operations will shortly be expanded to take in practically all of our provincial highways. An argument for so doing might be advanced by stating that a man, living in the town of Pembroke, who owns and operates a car or truck, and paying the same license fee as the man in Ottawa or Toronto, is entitled to the same privileges of the open road during the winter. Pembroke last fall became snow bound on Oct. 24 and the road leading thereto remained blocked until after April 1. Another reason that might be cited is that even the farmers living on the side roads are beginning to appreciate the opening of provincial highways in winter. They have learned that it is no longer necessary to store away their motor cars and trucks with the first heavy snow storm as it is not a very difficult matter for them to arrange to leave their cars or trucks at a friend's farm, or handy village along the highway, and use their sleighs to drive back and forth to their homes on the side roads. The proposed plan mentioned earlier in this discussion, of equipping patrol trucks with plows, supplemented by a heavy rotary unit, would in my opinion lend itself admirably to keeping all highways clear in the Ottawa district and there are a number of other districts where a similar plan and organization could be used to advantage.

Snow Fencing Practice.—A few remarks on snow fencing as practiced by our department may be of interest. We are using as a standard the 4 ft. wire bound slat fence, with slate 3/8 in. thick, in 100 ft. rolls. Last year a 5 ft. fence, with slats 1/2 in. thick, was used in some sections where exceptional drifting occurred and while this latter type of fencing costs 2 ct. per foot more, it is considered the additional cost is justified for the results secured. We have quite a number of manufacturer supplying snow fencing in Ontario and it has been noticed that there is considerable difference in the quality of wood used in the slats. A good quality of wood used means longer life for the snow fence. It is also well to look into the quality of the wire used for binding slats when purchasing the fencing.

Another View of the Merivale Road on March 22, 1932

Snow Removal on Merivale Road near Merivale, Ont., on March 22, 1932

The question of a longer snow fence post being used, up to 10 ft. in length, is worth considering where it is anticipated the fence will require lifting but with us it has been found to be rather a tedious job and may result in considerable damage to the snow fence where it is frozen in at the lower edge. In the Ottawa district on several side hill sections double rows of 4 ft. fencing, one above the other, carried on 2 by 4 lumber properly braced, has proved very effective and the two by fours are used at these locations from year to year.

Treatment of Icy Road Surfaces.—The problem of taking care of slippery conditions due to ice and frozen snow will vary almost directly in proportion to the amount of snowfall and it has been found that the amount of calcium chloride required to keep stock piles of sand or cinders from freezing and also of exerting a melting action on the icy surfaces after application of the sand will vary according to the average temperatures of the locality. In the Toronto district 30 lb. of calcium chloride is usually sufficient while in the Ottawa district 50 lb. is barely adequate. In the southwest end of our province, sheds have been erected with facilities for heating sand and in this particular locality, with a comparatively mild climate, this method has proved quite satisfactory.

Sanding of icy roads to be effective must be done without delay and as speedily as possible. The use of a sand spreader for this work, hauled by a truck, is much preferable to spreading from trucks by hand. On night work, which is very often necessary, good lighting must be provided at rear of truck so that men may see to work and also to protect them from traffic.

In the Toronto district, where the snowfall is usually rather light, the treatment of icy road surfaces is a greater and more expensive job than snow clearing. C. H. Robbins, Resident Engineer in charge of this district, advised me the department was so well organized for this work that in slightly over an hour after icy conditions were reported, day or night, the roads would have been sanded. Providing of sand or cinder stock piles and consequent renewal of supplies of these materials during a season of frequent icy conditions represents a large proportion of the expense attached to sanding operations. However, the users of our highways demand this service and if it were not done, we might in consequence expect a larger number of serious, if not fatal, accidents.

Acknowledgment.—The foregoing is an abstract of a paper presented Sept. 13 at the annual convention of the Canadian Good Roads Association.

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POWER and STAMINA
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At Left: An International Model A-7 Truck cutting through the snow in upper New York state last winter.

Below: This shows the Model A-7 when its front end is out of the snow. International Truck sizes range from ½-ton to 10-ton and meet every hauling need.

● Every year more INTERNATIONAL TRUCKS and McCORMICK-DEERING TRACTORS are brought into the fight to keep the roads of the snow belt open—because they've got the power and stamina to buck the drifts twenty-four hours a day.

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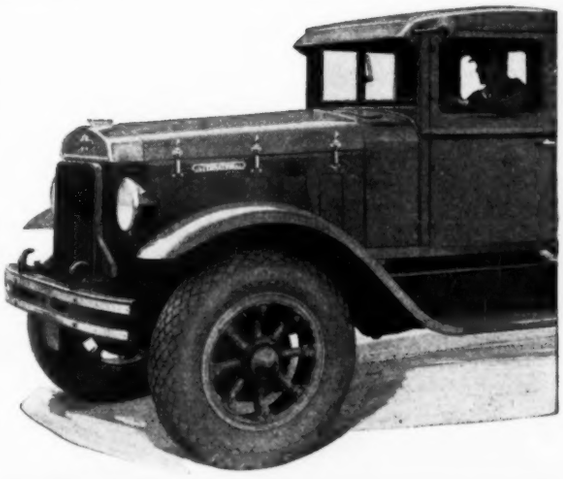

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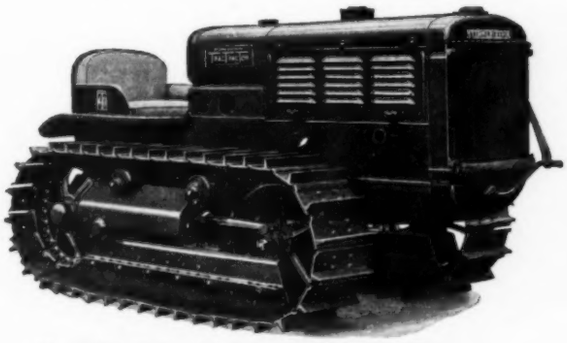


Above: The McCormick-Deering T-40 TracTracTor.
At Right: The T-40 opening a road through the mountains. The McCormick-Deering Industrial Tractor line includes the T-40 TracTracTor (gasoline or Diesel engines); the T-20 TracTracTor; four sizes of wheel tractors; and three power units, including one with Diesel engine.

WINTER ROAD MAINTENANCE IN QUEBEC

By A. CHOURCHESNE

Divisional Engineer, Quebec Provincial Highway Department, Montreal, Que.

THE question of winter roads was first raised in 1928, when the Department of Highways at Quebec, acceding to requests made by autoists in general (both trucks and ordinary machines being represented), decided to maintain winter roads in different sections of the province, and provide means of transportation to sections that were formerly snowbound during the winter months. This question was an important one, but once a decision had been reached, and winter roads were to become a reality, the department turned its attention towards applying the most efficient, and yet economical, method by which its object could be attained. With this end in sight, the department obtained such equipment as was necessary, and maintained a total of 85 miles of highway during that first winter. Yearly increases in mileage occurred, until last year a total of 400 miles was being maintained by employes of the department of highways.

It might not be amiss to point out that the department could have maintained a much greater mileage than was actually done, and, had all requests been granted. This would have been done, but after considering the equipment at its disposal, and the possibility of adverse weather conditions, rendering the maintenance of bigger circuits impossible, it wisely decided on maintaining only such mileage as it was sure could be kept open.

Last year's figure was 400 miles, as stated above, but in addition to this mileage interested parties kept open another 100 miles of roads which, however, were not always in the best of condition, due largely to the fact that those interested in their maintenance did not possess adequate equipment, and also to the fact of there being no snow fences to help protect the roads.

Snow Fences.—Snow fences, of a standard height of 4 ft., were used by the department from the first day they decided to maintain winter roads in the province,

View of Highway No. 8 in Winter of 1933-1934

Snow Removal on Highway No. 8 in 1932

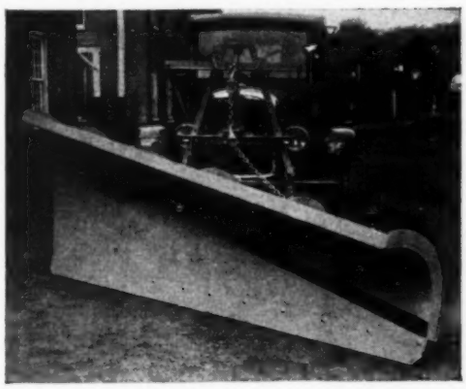
and they have proved their worth, since they have saved both time and expense, especially at the start of the winter, when insufficient snow has fallen to enable banks to be made. Snow fences also help eliminate the use of the snow plow.

During the first winter snow fences were placed over a total of 8.5 miles, this being 10 per cent of the mileage maintained, and they were found to be of such assistance that the percentage was gradually increased, until it reached 30 per cent in 1933, and this percentage is to be increased another 10 per cent, making a snow fence at an average distance of every 400 yd.

Snow fences were raised occasionally last winter, due to the exceptionally heavy fall of snow, and the suggestion is now advanced that the length of fence posts shall be increased to 9 or 10 ft.

At some points snow fences were made from local material, of proper size and at a smaller cost than would have been possible had the standard type been procured. These fences, however, could not be removed with the same ease as standard type fences, and accordingly were piled at spots where they are required.

There is no law in the province of Quebec which permits the department of highways erecting snow fences on private property, where necessary, but landowners, who realize the necessity of fences, have agreed to their being erected on their property. Up to the present not a single complaint has been made by a landowner because snow fences have been put on his property. Moreover, the department repairs farmers' fences and does such work at the start of spring thaws as will free them from damage.



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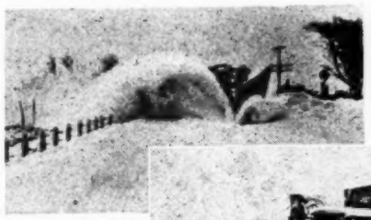

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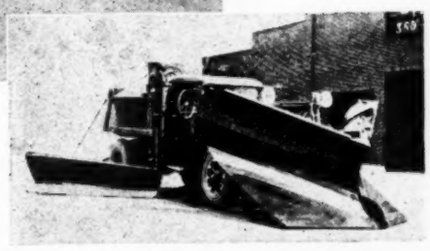

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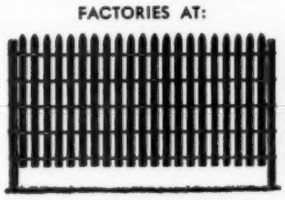

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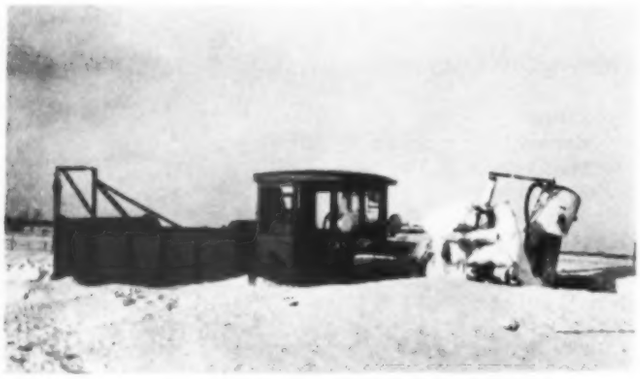
Snow fences are put up in localities where roads are narrow, on top of both sides of cuts, and in spots where snow banks are liable to form.

Wooden poles, which indicate culverts, ditches on narrow roads and dangerous curves, are set up at the same time as snow fences, and are especially valuable in spring. These poles also serve as a safety sign to truck drivers who are working on the roads.

Snow Removal.—This work is carried out by trucks equipped with V-plows and side wings. The trucks are of the F. W. D. type, and are of 3½, 5 and 7 tons capacity, and each of them is assigned to a section some 20 miles in length. Due to the many hills and narrow roads, which entail arduous work on the part of the plows, four wheel drive type trucks are employed.

I would like to point out, however, that ordinary trucks, equipped with V-plows, were used by those who maintained the 100 miles of winter roads independent of the provincial system.

All trucks and blowers used on roads maintained by the department of highways are owned and operated by the department, and are inspected daily, with experienced mechanics effecting whatever repairs may be necessary, in the department's garages. Mechanics, drivers and helpers hold themselves in readiness to work day or night, Sundays or holidays, as they may be required.



Snow Removal on Highway No. 8 in 1933

Patrolmen inspect the roads daily, and whenever a road needs attention, they inform the despatcher, who immediately sends such equipment as is necessary to deal with whatever is reported by the patrolman.

Whenever brush is found near the roads in the fall, it is cut down, this preventing snow from accumulating at the fence during winter months.

The department's policy, that of widening highways, facilitates the maintenance of winter circuits, since it results in more space for snow removal, with less work as a result.

Daily Reports.—Daily reports, containing information as to the condition of roads, work performed each day, etc., are sent in to the head office each day. There they are kept for reference in supplying the public with information.

Ice Conditions.—Particular attention is given by the department to the keeping free of ice certain stretches of road where bad conditions prevail, such as railroad crossings, dangerous curves and hills, but due to the high cost of maintenance sanding is used only at these points, the department being of the opinion that it would be too expensive to cover the whole of the mileage maintained. Ice is an important matter, which has been given a good deal of attention by the department.

When the road sags during winter small, crushed stone or gravel is used to fill in any holes that may be caused, thus protecting, to a great extent, the general good condition of the road.

Rotary Plow on Highway No. 14 in 1933

Cost of Snow Removal In Quebec Province.—A few remarks on the cost of snow removal in the province of Quebec will not be amiss. In Montreal the cost of snow removal was $316 per mile in 1933, this being for the Montreal district, while in Quebec and district the cost was $600 per mile, the difference being explained by the longer winter and heavier amount of snow in the Quebec district.

Equipment cost the department $587,000 up to 1933, this comprising eighteen F. W. D. type trucks and nine blowers. Depreciation and repairs represents an expenditure of more than $100 per mile. While this would seem to be rather costly, having regard to the mileage maintained, it would perhaps be advisable to state that winter conditions in Quebec province provide many and varied facilities for recreation for tourists who, by the way, take full advantage of all facilities offered, since motor traffic on our roads last winter totaled as much as 500 machines on some days, with a daily average for Montreal of 300 cars, all winter.

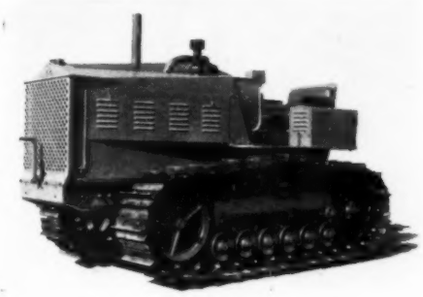
Acknowledgement.—The foregoing is an abstract of a paper presented Sept. 13 at the 21st annual convention of the Canadian Good Roads Association.

Snow Removal on Highway No. 2 in 1933

NEW EQUIPMENT AND MATERIALS

New Diesel Tractor

The Cleveland Tractor Co., Cleveland O., has announced the Cletrac 35 Diesel, which delivers a maximum of 46 horsepower at the drawbar. The engine is of the same general construction as the engine which has proven so satisfactory in the Cletrac Diesel 80. These engines have been



Cletrac 35 Diesel Tractor

in operation thousands of hours, working under all kinds of conditions. Embodied in the Cletrac Diesel 35 are the features of the Cletrac 35 gasoline tractor which has been tried and proven by years of service in both agricultural and industrial work.

The Cletrac Diesel 35 engine is of 6-cylinder design, 4⅜ in. bore by 5¼ in. stroke and operates at 1200 r.p.m. It has seven main bearings and the crankshaft is balanced with integral weights, resulting in a well-balanced, smooth operating engine. Removable liners are provided in the cylinder block.

A distinguishing characteristic of the Cletrac 35 Diesel is that it is equipped with electric starting which has proved so successful on the Cletrac Diesel 80. The Cletrac 35 Diesel is stated to be the first full diesel tractor in its power class to offer this convenient and money saving feature.

Standard equipment includes electric starting, radiator guard, crankcase guard and wiring for lights.

Hercules Ironer Roll

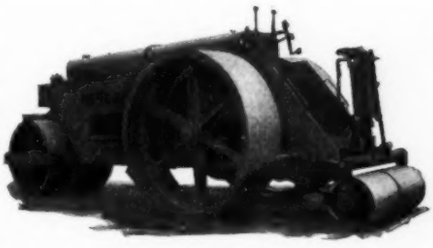
The Hercules Company of Marion, O., has announced their Hercules Ironer Roll, an attachment for their Hercules 3-wheel rollers. This ironer roll is an auxiliary roll of small diameter, mounted in place of and interchangeable with the scarifier. It is hydraulically operated, roller bearing mounted and has great flexibility in its operation, having a range from minus 6 in. to 6½ in. above grade, and hydraulic pressure range from zero to 300 lb.

In operation, it is stated, a weight corresponding to more than 50 per cent of the total weight of the entire roller may be exerted on this auxiliary roll, and as the small diameter of the roll provides a shorter arc of contact with the material being rolled, better compaction is obtained, high spots are eliminated and uniformly level surface obtained.

An important factor in the operation of this Hercules Ironer roll is the positive-power-control which automatically maintains proper traction on the rear driving wheels at all times.

It is claimed that placing this auxiliary roll at the rear of the Hercules three-wheel roller, a perfect plane is obtained about 17 ft. in length. This long plane surface successfully eliminates short waves in the road surface which ordinary rollers, whether tandem or three wheel, do not eradicate.

It is stated that a smooth level surface, free from wheel marks, is obtained with a few longitudinal passes of the Hercules roller equipped with this ironer roll. Less rolling time is required to complete the job and the necessity for cross rolling is eliminated. This last feature is particularly desirable where it is necessary to maintain



Hercules Ironer Roll Attached to Roller

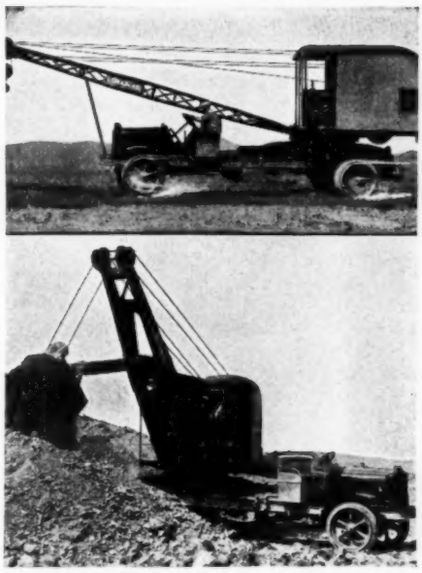
traffic during construction as a single traffic lane may be repaved with this equipment without obstructing the second lane.

New Truck Mounted Cranes and Shovels

The Universal Crane Co., Lorain, O., has recently announced a new series of motor-truck mounted cranes and shovels.

These are known as the Universal-Lorain 40-37 and 30's, and have crane lifting capacities, of 8½, 7¾, 7½, 6½ tons at 10 ft. radius. Crane booms are 25-30-35 ft. in length and may be equipped with straight boom tip extensions 5-10-15-20 ft. long to afford a maximum 55 ft. boom. Gooseneck extensions of 5-10 ft. are also available.

The shovel boom is a full shipper shaft type, rope crowd, of the same design as



New Truck Mounted Crane and Shovel

used on crawler machines. Dippers are furnished in ¾-½-⅜ yd. sizes.

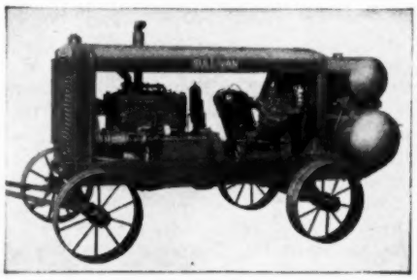
The units are full revolving, one-man operated units powered by six cylinder gasoline engines. They are built to the Thew Center Drive principle, in which it is claimed that the unit is so balanced as to keep weight to a minimum, thus enabling the unit to life 6½-8½ tons, with a total turntable weight suitable for mounting on 5-7½ ton motor trucks of standard makes.

New Portable Two-Stage Compressor

A new portable air compressor has been announced by the Sullivan Machinery Co., Chicago, Ill. This new compressor is a two-stage design of the angle or "V" type with the air end air cooled. This design reduces fuel consumption which is also decreased by a new Wafer valve of exceedingly large port area and very low lift. The design of air ports and air piping provides minimum resistance to air flow. The base is welded structural steel. The main bearings are ball bearings. The number and weight of all reciprocating parts are reduced to a minimum.

There has been retained in the assembly the line of heavy duty industrial type engines which have proven so highly satisfactory in previous Sullivan portable compressors.

The new Type WK60 is provided with all modern compressor and engine accessories such as air cleaners, and oil filters.



Sullivan Type WK60 Air Compressor

Type WK60 portable air compressor is now available in the four sizes in greatest demand. All of them may be obtained in any kind of mounting—2 or 4 wheel—steel tires or either kind of rubber tires—or mounted on a truck.

International Harvester Announces New Stream-lined Truck Models

The new streamlined International trucks just announced by the International Harvester Co., Chicago, Ill., include models ranging from ½ to 5 tons in capacity. The forerunner of this new line, the half-ton Model C-1 announced some time ago, has met with enthusiastic approval and the larger models now being shipped from the factory carry the same distinctive lines and attractive finish.

The new models include the C-20, 1-1½ ton rated capacity, which has a maximum allowable gross weight of 8,300 lb. It is powered by a four-cylinder engine and is built in two wheelbases; namely, 133 and 157 ins. The 6-cylinder Model C-35, avail-

International Model C-55.

able in 136, 160, and 175-in. wheelbases, is powered by an International Harvester Model FAB-3 valve-in-head engine which develops 78 hp. at 3400 r.p.m. and 160.4 pound-feet torque at 800 r.p.m. Compression ratio is 5.4 to 1 and displacement 222.7 cubic inches. The rated capacity of this model is 1½-2 tons, with a maximum allowable gross weight of 10,400 pounds.

The Model C-40, rated at 2-3 tons with a maximum allowable gross weight of 13,000 lbs., is equipped with the same power plant as the C-35 but instead of a four-speed conventional-type transmission the C-40 has a five-speed transmission with one reverse. Helical constant-mesh gears in third and fourth speeds assure quiet operation. This model is available in 145, 155, 170, and 185-inch wheelbases.

The Model C-50 has a maximum allowable gross weight of 16,100 lb. with a rated capacity of 3 to 4 tons. It is built in 145, 156, 170, and 185-in. wheelbases. This model is powered by the 6-cylinder valve-in-head International Model FBB engine, which like the FAB engine employed in the Models C-35 and C-40 has replaceable cylinders, exhaust-valve seat inserts, replaceable precision-type bearings, and other features which contribute to its economy and efficiency. The Model C-50 engine has a 3⅝-in. bore and 4½-in. stroke with displacement of 278.7 cu. in. It develops 82.3 hp. at 2,800 r.p.m. governed speed and a peak torque of 191 pound-feet at 800 r.p.m. The rear axle is of the spiral bevel gear full-floating type.

The Model C-55, built to sarry a total of 14,000 lb., including body, cab, and equipment, and rated at 3½-4½ tons, has a maximum allowable gross weight of 21,500 lb. The Model C-60, 4-5 tons, has the same maximum allowable gross weight.

These models are alike with the exception of the rear axle. The Model C-55 has a spiral bevel drive-gear rear axle, while the Model C-60 has a double-reduction axle with herringbone gears for the first reduction. Both rear axles are of the full-floating type. These models are built in 140, 156, 170, 190, and 210-in. wheelbases. The power plant of the Models C-55 and C-60 is the six-cylinder International Model FBB-3, also of the valve-in-head type, with replaceable cylinders, valve-seat inserts, and other important features. This power plant—bore, 3¾ in.; stroke, 4½ in.; displacement, 298.2 cu. in.—develops 90.4 brake horsepower at 2800 r.p.m., its governed speed. Its peak torque is 213.5 pound-feet at 800 r.p.m.

All these new Internationals are of the same streamlined design which is carried out in cabs and in panel bodies. Suitable body types to meet all hauling requirements are available for each of the new Internationals.

New Osgood—"Victor Special"

The Osgood Company, Marion, O., has just completed and, after exhaustive tests under all conceivable conditions, is ready to place on the market—the new Osgood 1½-yd. machine named Victor Special.

This Victor Special is convertible from one class of service to the other without the necessity of any machinery changes whatsoever, all that is needed is to change the front end equipment and that can be done readily in the field, if necessary, within a space of two hours. All the operating machinery lies well back of the center line of rotation, which gives the machine the best possible balance and allows it to lift its required and stated load with the use of the least possible amount of counterweight.

Virtually all the machinery shafts are carried in anti-friction bearings. The shafting is all of vanadium steel alloy. The gears and pinions are all of steel of special analysis, best suited for the points at which they are used, and all on the upper body have teeth cut from the solid blanks.

The Victor Special is available with gasoline engine or diesel engine or single electric motor drive. In either case ample power is provided to do all the work a machine of this capacity is called upon to perform without taxing the prime mover to its limit. Transmission from the power unit to the machinery proper is by means of the heavy silent chain, a drive which provides the most elasticity and does its work with the least friction.

The upper revolving body and the lower body and roller path upon which the machine rotates and the side frames which carry the continuous tread or crawlers are all of one-piece steel castings titanium treated and thoroughly annealed. The crawler treads or pads are of manganese steel alloy joined one to the other with lugs having seven points of contact and special alloy steel pins.

The Victor Special is stated to be unique in that it is so designed that almost any combination of line speed and line pull can be provided to suit the purchaser's particular needs. Its flexibility in this respect is something which has been sought by the designer and desired by the purchaser for a long time past.

As a shovel—the Victor Specal carries a steel boom of the inside type, heavily diaphragmed throughout its length and outside type dipper handle and full manganese dipper.

As a crane or dragline or clamshell unit, it is furnished with boom of required length to suit the purchaser's particular needs.

Steering is under full control of the operator from his position at the levers. Protection for the operator and a full view of his work is afforded by glass windows in steel frames and the construction of the steel cab which is cut back on the opposite side, to afford clear vision. A running board is also provided for operator's convenience, and the assembly of machinery and means afforded for lubrication and adjustment, and the slight amount of physical effort needed to operate the machine are such that the biggest possible output is assured the owner at the minimum amount of effort on the part of the operator.

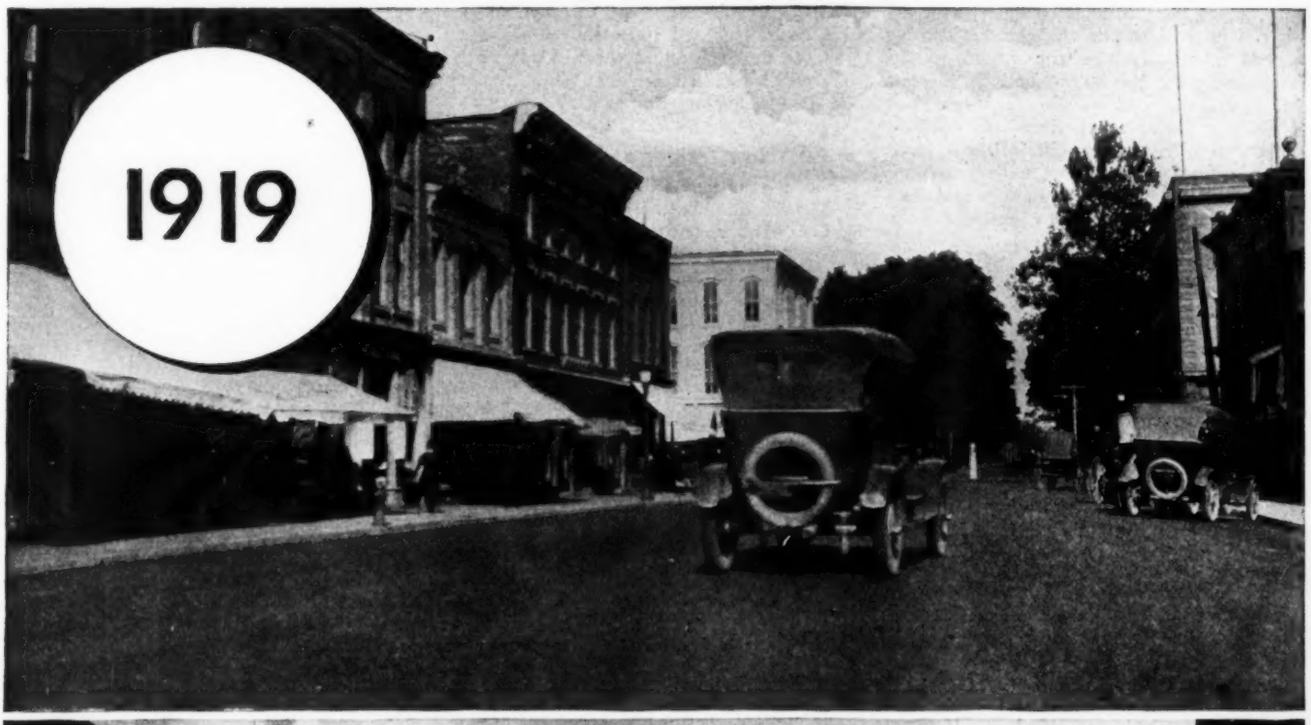
Additional information and specifications on the Osgood Victor Special may be obtained from all Osgood Distributors or from the Osgood Co. at Marion, O.

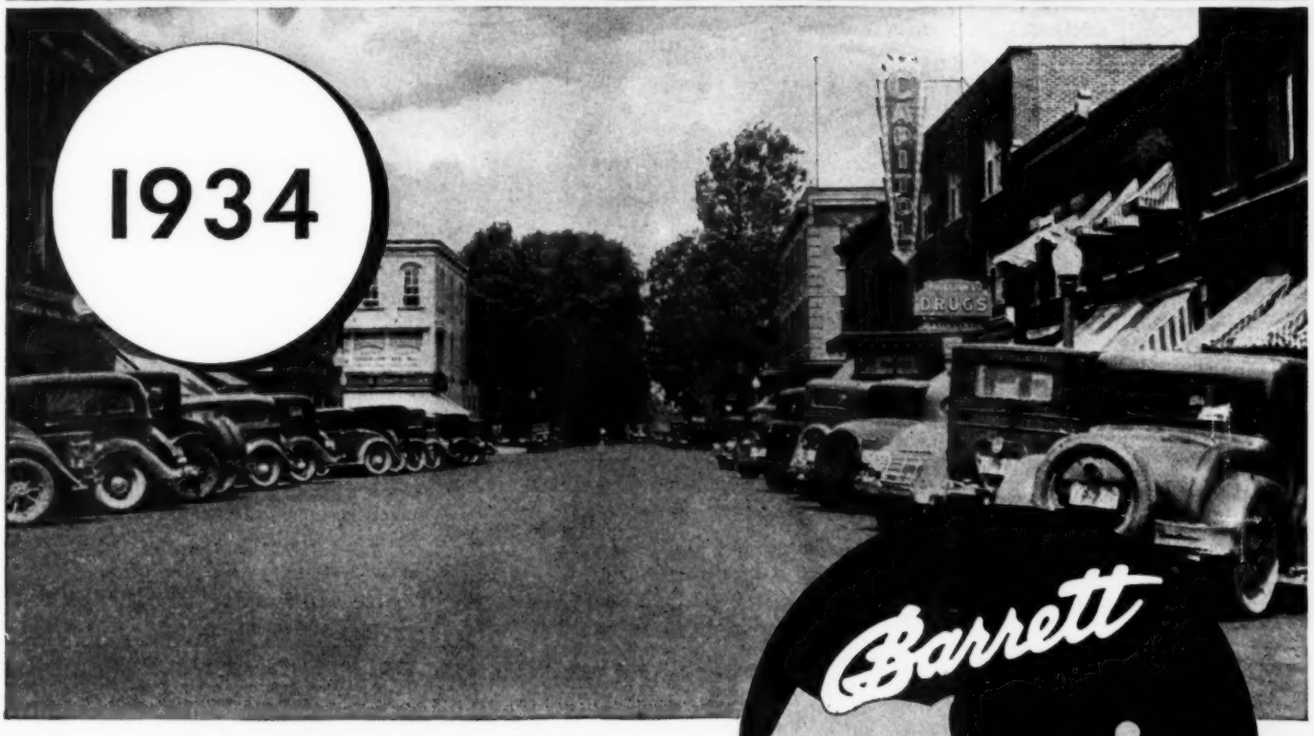
New Heavy Sinker Drill

A 3-in. sinker drill (the CP-52 Sinker) for heavy sinking, particularly in hard ground, long hole quarry drilling and in broken, "ravelly" formations where fast drilling speed, strong rotation and exceptional hole cleaning are required, has been brought out by the Chicago Pneumatic Tool Co., 6 E. 42nd St., New York. The drill is symmetrical, well-balanced and, being fully cushioned and valve-actuated, maintains its drilling speed under varying air pressure and does not fog or "freeze" with wet air. The valve is rugged, fast and positive in action, giving powerful rotation. It is housed in a renewable case within the cylinder and bushings at points of wear and automatic lubrication insure long life and low maintenance. Effective continuous

The CP-52 Heavy Sinker Drill

Norfolk Street, Simcoe, Ontario, Canada. Tarvia-built in 1919. The upper photo was taken in 1921; the lower shows the condition of Norfolk Street today. The contrast in traffic conditions shows the change in urban life during the past fifteen years . . . a change made possible by good roads.





● **Tarvia roads can be built and maintained in weather that often compels suspension of work on many other types of roads. For last minute jobs, for necessary repairs and maintenance or for road-building to provide emergency work far into the winter, Tarvia provides a logical and economical answer. The cooperation of Tarvia field men places the unmatched facilities and thirty years' road-building experience of The Barrett Company at your service. 'Phone, wire or write our nearest office.**

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GOOD ROADS AT LOW COST

THE BARRETT COMPANY

New York Chicago Philadelphia Cleveland Birmingham St. Louis Lebanon Minneapolis
Toledo Milwaukee Detroit Baltimore Columbus Youngstown Boston Buffalo Providence Syracuse Hartford Cincinnati
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and emergency blowing keeps the hole clear of cuttings. For hard ground and short holes, where continuous blowing is unnecessary, the CP-52 can be equipped with an air rod in place of the air tube. A sturdy, forged, spring-cushioned retainer effectively holds and pulls the steel and it is easy to operate.

Tests in various sections of the country are stated to have shown the CP-52 to have high drilling speed over a wide range of formations, good holding qualities and that holes can be kept clear of cuttings to a depth of 25 to 30 ft.

The CP-52W (Wet) Sinker, identical in make-up with the CP-52, except for minor details, is available where wet drills are required. The change from dry to wet, and vice versa, is quickly and easily made.

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New Closed Back Shovel

A new shovel has been announced by The Wood Shovel & Tool Co., Piqua, O. This new shovel is known as the Wood's Closed Back and, in many ways resembles the familiar hollow back type except that, instead of the usual hollow in the back of the blade, there is a steel plate welded securely to the blade and extending up into the socket. The upper part of the plate, however, is free to permit flexing and, since there is no strain on the insert, it cannot pull loose. By this construction, the one-piece steel blade is made smooth both front and back, and yet permits the use of the tapered socket which, according to Wood's engineers, is heat-treated to provide greater strength and springiness than a heavy solid shank offers. Another advantage claimed is that, with this type of socket, the lift or bend usually only found in plain back shovels is applied in this new model.

Other features in the Wood's Closed Back shovel are the straight handle and turned shoulder. To replace a handle it is only necessary to push the new handle into position and replace two rivets. The turned shoulder consists of a lapping over of the metal at the top of the blade and the pressing of this double thickness of metal into a sturdy beading which gives greater strength to the frog, eliminates blade splitting and provides greater foot comfort for workers.

Wood's Closed Back Shovel

An illustrated eight-page booklet on the new Wood's Closed Back shovel has been prepared by the manufacturer. Copies may be secured by writing The Wood Shovel and Tool Company, Piqua, O.

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New Tractor and Trailer

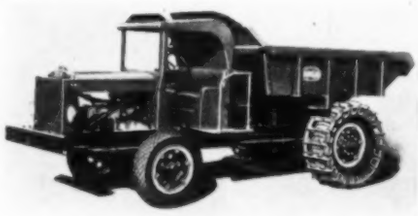
A new rear dump trac-truk brought out by The Euclid Road Machinery Co., Cleveland, O., has an exceptionally short wheel base and in addition is equipped with two supplementary fast operated steering brakes.

The specifications include the following:

Engine—Six cylinder Model SRK Waukesha, 4⅝ in. bore x 5⅛ in. stroke, delivering 100 hp. at 1800 r.p.m. Electric starter and battery standard equipment.

Speeds—First speed is 3.1 miles per hour. Second, 6.0 miles per hour. Third, 9.8 miles per hour. Fourth, 13.5 miles per hour. Reverse speed is 2.5 miles per hour. (These speeds based on 12.00 x 24 tires with tracks.)

Capacity—Live load weight capacity is 20,000 lb. Body level content capacity is 6 cu. yd.



New Euclid Rear Dump Trac-Truk

Dimensions and Weight—Wheel base is 10 ft. 10 in. Length over all is 20 ft. 4 in. Width over all 8 ft. Wheel spread center to center 6 ft. 6 in. Loading height 7 ft. Inside width of body at top 7 ft. 4 in. Inside length of body at top 10 ft. 6 in. The net total weight is 15,000 lb. without tire tracks.

Body—An all-steel, one-piece body using 5/16 in. double plated bottom with 2 in. oak planking insert between bottom sections. Sides and ends are constructed of ¼ in. plates with heavy reinforcements of top and sides. Mounting is on coiled springs. A guard plate is mounted forward and extends over top of cab for protection in loading.

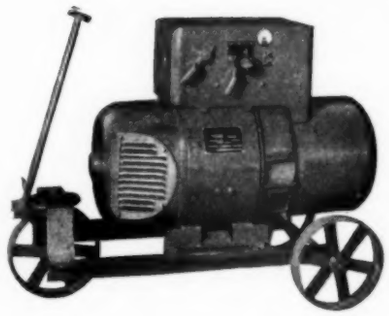
Frame—The frame is extra heavy, being constructed of 10 in. ship channels.

Axles and Wheels—Rear axle, equipped with ball bearings, is a heavy duty Euclid double reduction type with independent foot operated steering brakes for each wheel. Front axle is heavy duty truck type with wheels mounted on roller bearings.

▼

New Line Arc Welding Sets

A line of improved, portable, single-operator arc-welding sets which retain the proved characteristics of previous models and incorporate recently developed refinements, is now offered by the General Electric Co. of Schenectady, N. Y. Self-stabilization is the outstanding feature of the new arc welders—an advantage which is stated to provide excellent performance throughout the entire welding range, using any type of electrode, bare, lightly fluxed, or heavily coated.



New G. E. Arc Welding Set

The improved welders belong to what is designated as the WD-30 line. Each welder is a self-contained unit, having no external reactor, resistor, or separate exciter. It is largely due to the self-excited design of these machines that the inclusion of sufficient self-stabilization to provide steady welding characteristics under all conditions is possible. This self-stabilization makes the welding arc both "peppy" and stable at all times.

Separate controls are provided for adjustment of welding current and welding voltage. These controls are located on a dead-front panel on top of the machine and at the most convenient height above the floor. On this panel are also located a switch handle for reversing polarity and an instrument with selector switch for indicating welding current and welding voltage. All controls are clearly labeled to facilitate rapid and accurate adjustment.

Commutation is excellent at all current values, and operating efficiency is claimed to be high because of the lack of power-consuming accessories such as external reactors, resistors, and separate exciters.

All working parts of the machine are thoroughly protected against damage from water or other foreign materials by completely drip-proof construction.

The entire welding set is low-hung on a three-wheeled truck which provides unusual portability and mechanical stability, without sacrificing road clearance. The set may safely be tipped as much as 22 degrees from the vertical.

▼

New Device for Batching Scales

A new device for batching scales or any beam weighing scale over which predetermined weights are obtained has been placed on the market by the Best Scale Co., 1123 Adon St., Pittsburgh, Pa. Outstanding features claimed for the device include:

Simple and easily attached to any beam scale.

Indicator is visible from both sides at much greater distances.

Electric connection is positive without friction.

Alarm bell and flash light is placed as may be desired by purchaser.

No dash pot, broad fan controls oscillation to a smooth even movement.

Rugged and simple construction.